The Empire Cotton Growing Review

Journal of the Empire Cotton Growing Corporation

Vol. VII. 1930

Edited by
J. C. WILLIS, M.A., SC.D., F.R.S.

Published by
P. S. King & Son, Ltd., 14, Great Smith St., London, S.W. 1
for the Empire Cotton Growing Corporation

Quarterly: Price 1s.
Annual Subscription, 5s. post free

Printed in Great Britain

HE EMPIRE COTTON GROWING REVIEW

THE
EMPIRE COTTON GROWING
REVIEW

VOL. VII. JANUARY, 1930. NO. 1

WORKING CATTLE IN NYASALAND

BY

H. C. DUCKER.

To anyone acquainted with Indian conditions, the following account of methods used in working cattle on the Corporation's Experiment Stations in Nyasaland will contain little that is new. It is hoped, however, that it may be of use to workers dealing with similar conditions in other parts of Africa.

When in 1921 Mr. H. C. Sampson first visited Nyasaland he found that the methods employed in cultivation with cattle were those developed in the Union of South Africa, and gave it as his opinion that the methods of Southern India might be better suited to the country's requirements. Essentially, the main differences between the two types lie in the use of large teams of led oxen in the Union as opposed to small teams of driven oxen in India. It follows, therefore, that the implements in use in India are lighter and more easily handled than are those generally employed in the Union, and are therefore more likely to be suitable for peasant cultivators. This is of particular importance in Nyasaland, since the trend of the country's development is in the direction of peasant production as opposed to large-scale European estates.

In 1923 the Makwapala Experiment Station was opened and stocked with eight bullocks obtained from the Government Farm at Namiwawa. The cattle are grade stock bred from native cows by Shorthorn and Sussex bulls, and contain a considerable admixture of Zebu blood. They are hardy, and do well under the Makwapala conditions.

A suitable building was erected with stall accommodation for the eight cattle, and an Angoni cattle boy was engaged who had had considerable experience in working cattle in Southern Rhodesia.

The first step, when the cattle were taken over, was to fit them with nose ropes. The nostrils of each beast were pierced with a bull ring punch in the ordinary way, but, instead of a ring, a smooth hemp rope about ⅜-inch diameter was threaded through the hole and its ends knotted behind the horns of the bullock. In about five days the holes were healed, the ropes keeping them open. The bullocks were then ready for breaking.

They were first matched in pairs, and each pair in turn trained to the yoke, an ordinary four-foot yoke of South African type being used. This was done by yoking up each pair for an hour or so each day and driving them around the Station by means of reins consisting of a 10-foot length of cord tied to the nose rope of each bullock between the horns. No whips were allowed, but the boy carried a long, thin, bamboo switch with which it was impossible to hurt the bullocks. No shouting was allowed, and the bullocks were gradually accustomed to being driven quietly about the Station, and to obey various words of command enforced by the aid of the nose ropes. In order to turn, it was merely necessary to check one bullock by means of its rein, and to urge on its companion. To stop, all that was required was to pull on both reins at the same time. It was found that the great leverage obtained by the aid of the nose ropes could, without harm to the bullocks, give very considerable control over their movements. Within a few days they had learnt the simple evolutions required of them and the various words of command for these evolutions.

The next procedure was to accustom them to hauling a load. For this purpose a small log was attached by a chain to the yoke and the cattle trained to pull this about the cultivated land. When each pair had learnt to drag their load quietly, and to turn, stop, and back as required, they were considered broken for the plough. It says much for the efficiency and simplicity of these methods that the first pair were broken and had started ploughing within a fortnight of the beginning of their training.

From the time of their arrival at the Station the bullocks were trained to stall feeding and stabling at night, and were groomed every day with an ordinary curry-comb and brush. Apart altogether from the benefit to the bullocks' health derived from the regular feeding and grooming, the continual handling they received made them thoroughly tractable and trustful of their attendants.

Feeding has consisted of grazing, concentrates of various kinds, and fodders. The grazing available at Makwapala, however, is of very poor quality and the stall-fed concentrates and fodders comprise by far the most important part of the bullocks' rations.

BULLOCK'S HEAD SHOWING N[illegible]

PLOUGHING BETWEEN RIDGES WITH SABLE PLOUGH — HEAD ON VIEW

HARROWING WITH SPRING TINE DRAG HARROW — 4 FOOT YOKE

RIDGE TERRACER WIDENING RIDGE TO CHECK SOIL EROSION

Concentrates in use are as follows: maize meal and meal of other cereals, such as sorghum, pearl millet, finger millet, etc., if and when available; beans, soaked, kibbled, or ground, such as *Mucuna utilis*, the velvet bean, *Cajanus indicus*, and cotton seed, fed whole after soaking, or as cake. The latter, now obtainable in Nyasaland as decorticated cotton cake, is in use at the time of writing (September, 1929).

Fodders are supplied mainly by the various crops such as maize straw, the haulm of various pulses, etc., and are supplemented in particular by the elephant grass, *Pennisetum purpureum*, indigenous in Nyasaland. This grass makes a very good coarse hay, and grows well with little cultivation. Three cuttings annually can easily be obtained.

From 1½ to 3 lbs. of concentrates are fed to each bullock per diem, the quantity being varied with the bullocks' condition and with the work they are being called upon to perform. This ration is fed in the evening, before bedding down the bullocks for the night. Fodder is supplied liberally, and a small handful of salt is given to each bullock weekly.

Beyond moistening the concentrates, all feeding is done dry, no succulents being given. What small amount of grazing the bullocks are able to get supplies any deficiencies in the diet.

Two shifts are worked, 6 a.m. to 10 a.m., and 4 p.m. to 6 p.m., so as to allow the cattle to rest, graze, and be watered during the heat of the day.

It would appear that there is very little wrong with the system of management outlined above, seeing that the eight bullocks have now completed a six-year working life and are still looking fit and working well.

A series of cattle boys have been trained, and it has been found that even natives into whose tribal life cattle do not enter can be accustomed to bullocks and work them satisfactorily by the methods in use on the Station. It must, however, be admitted that the best results have been with boys from cattle-owning tribes like the Angoni.

The first implements used on the Station have already been described by Mr. Sampson.* These were of types in use in Southern India, in part imported and in part made locally.

They were used with fair success for the first four years of the Station's existence, but it became increasingly obvious that, though with constant supervision they could be used with more or less

* E. C. G. Review, vol. ii., p. 317.

efficiency, they were not well suited to the mentality of the Nyasaland native.

In "Reports received from Experiment Stations, 1927-28," the writer gave it as his opinion that what were wanted were light implements constructed as far as possible of iron, which would not easily be broken, and for which spare parts could be supplied from stock.

A collection of more suitable implements is now being formed, and additions are being made to it as quickly as possible.

While it has been found advantageous for the operator to be close to his bullocks, it has not proved absolutely necessary for him to be very close, and both at Makwapala and at Port Herald this season Sabul ploughs with chain draughts have, with ease, done their ½ acre per day.

The following is a list of some of the implements in use:

Ploughs: Sabul, R.H.R.L. ridger, D.Y. ridger and cultivator, all made by Ransomes.
Harrows: The "Ladder" (a rough, locally-made implement); spring tine drag harrows, also made by Ransomes.
Cultivators: Planet Junior and John Deere inter-row cultivators.
Planters: Single-row planters by Avery.
Ridge terracer: Martin ditcher and terracer.

Preliminary cultivation for cotton at Makwapala is now carried out as follows: the land is first ploughed with a Sabul plough, using two bullocks with a 4-foot yoke. It is then roughly ridged with the R.H.R.L. ridger, using two bullocks and an 8-foot yoke, thus making ridges 4 feet apart. It is next ploughed again between the ridges; the ridges are then split back, and the land between them again ploughed. An 8-foot yoke is also used for the ploughing between ridges. This gives a cultivation depth of 9 to 10 inches, and leaves the land laid up in rough wide ridges to await the break of the rains. As soon as rain makes the operation possible the ridges are harrowed down to a planting tilth, and the cotton sown on a low, wide bed 4 to 5 inches high.

The whole cultivated area at Makwapala has now been ridge terraced to check soil erosion, check ridges being thrown up at 3-foot vertical distances. The major part of this work has been done with the ridge terracer; two pairs of bullocks in tandem are required in order to finish off the ridge, but this was found quite easy with one driver.

Harrowing, laddering, and planting, using a single-row planter, are all performed satisfactorily, using a 4-foot yoke, but for a double-row planter an 8-foot yoke is necessary.

Two sizes of yoke—4 and 8 foot—measured from the centre of one bullock's withers to the centre of the withers of the other bullock, are all that are required for a standard row width of 4 feet. For other row widths different sizes of yoke are necessary, so as to bring the bullocks to the centre of each row interval.

Inter-cultivation of growing crops is satisfactorily performed using Planet Junior five-tine scufflers with an 8-foot yoke for cotton. With these, however, one bullock has to walk in the row just cultivated, and to obviate this enquiries are being made with a view to finding a suitable implement whereby the rows of plants may be straddled. With such an implement a short 4-foot yoke could be used, and the bullocks walk always on uncultivated land, two 4-foot row intervals being cultivated at once.

When working bullocks in growing crops it is, of course, necessary to muzzle them to prevent them from eating the foliage. For this purpose net-bag muzzles made of Sunn hemp string have proved quite satisfactory. Any similar fibre would, of course, be suitable.

Cattle are also used satisfactorily on the Port Herald Station, and a number of natives are showing interest in the methods used. One who lives near Makwapala has taken up our methods and is employing them with considerable success on his own gardens, as well as undertaking contract ploughing on his neighbours' gardens. At the Domira Bay Experiment Station, which is being opened for cultivation this coming season, it is hoped that it will be possible to use cattle by adopting the Makwapala methods, in spite of the fact that the new Station is within a tsetse-fly belt.

It is thought that by confining the cattle to the area under cultivation only, and not allowing them to graze in the surrounding bush, it will be possible to lessen the chances of their infection by trypanosomes. In addition, it is intended to surround the cultivated area with as large an expanse as possible of treeless clearing, by the encouragement of native gardens around the Station. This should further lessen the chances of tsetse fly reaching the cattle.

The cattle will have to be brought to the Station at night so that they may not be infected before reaching the cleared area, but this should not present much difficulty since the edge of the fly belt is only some ten miles away.

The Acting Chief Veterinary Officer, Mr. J. De Meza, is much interested in the scheme, and has offered to lend one of his Department's trained boys to watch the health of the cattle, and if necessary make injections. While Mr. De Meza does not think that it will be possible to prevent the cattle from becoming infected, owing to the

presence of mechanical carriers such as the Stomoxys flies, as well as to the chance of tsetse reaching them, he is of the opinion, however, that with the aid of trypanicidal agents a useful four to five years' working life per bullock may be obtainable.

Too much emphasis cannot be laid on the agricultural value of any scheme which may make cattle cultivation possible within Nyasaland's fly-belts, as anyone will understand who has had to depend only on hand tillage.

Received October, 1929.

THE EVOLUTION OF THE COTTON HAIR

BY

W. YOUNGMAN.

[*An account of the investigation into this subject by Mr. Pande and myself appears in the "Annals of Botany," No. 72, October*, 1929—W. Y.]

THE geneticist striving to improve the cotton fibre has been until now in the unfortunate position of working on a plant organ of whose evolutionary history, relationships, and function he knew little or nothing. He was placed in a very different position from one endeavouring to increase quantity or quality in the grain of wheat or the tuber of the potato, or to produce a new colour in the petal of a sweet-pea; for in such cases it was known what was the evolution and the part played in the life of the plant by the organs in which it was desired to bring about a change.

No satisfactory suggestion had been put forward to show what was the evolution of so complicated a morphology as that of the cotton fibre. Many suggestions have been made as to what were the functions of this hair upon the seed, but could only be speculations until we possessed more precise knowledge of the phylogeny of these hairs.

Investigation leading to increased knowledge of fundamental phenomena is often a necessary preliminary to the application of science in everyday life. In the case of cotton it is a necessity for the plant breeder, for the spinner, and for the dyer, and is capable of aiding eventually both agricultural practice and textile industry.

The corkscrew-like twistings of the cotton hair which enable it to be spun into a thread such as can be derived from no other so short a fibre, the pits to be seen in its wall at certain stages of its growth, the convoluted parallel markings so often seen along the length of the fibre, are unique properties peculiar to the hairs of the cotton plant and some of its relatives. It is concerning such unique properties particularly that an increase in our knowledge is especially to be desired.

To the plant breeder, who must frequently and necessarily be faced with the part played by phylogeny in shaping the present-day form of an organ, it seems but natural to look to evolutionary stages for information concerning morphological peculiarities. It was this idea that suggested the possibility and value of obtaining some

knowledge of the phylogeny of the cotton hair by a study of similar organs on allied plants. There are in nature many organisms that do not show of themselves how they have attained their present structure, but to which a key is obtained when a study of related forms is made. An investigation, therefore, was made of the epidermal outgrowths generally of plants belonging to the order Malvaceæ; and to a subdivision of this order, the Hibisceæ, especial attention was shown.

The Malvaceæ include a large number of present-day plants, many of which, such as the Mallow, the Hollyhock, the Hemp, the China Rose (or Shoeblack Plant), and the Cotton, are familiar. Nearly related to them are the Bombacaceæ, amongst which is the Tree-cotton (*Bombax*), a lofty tropical forest tree, which yields the "kapok" fibre of commerce. Of near affinity to these two families is a third, the Sterculiaceæ, the representative plants of which are confined to the tropical regions of the earth. The more one studies the individual plants of these families, the more unnecessary it seems to divide them into three distinct groups. There are gaps at places in our knowledge of their relationships, however we group the present-day plants of these orders, but this is perhaps because representatives of some of the lineage have died out.

In all these three orders of plants there exist, either fully formed or as rudiments, small umbrella-like or mushroom-shaped scales upon the surface of the organs. Such a scale in its most typical form is well seen upon *Thespesia populnea*, the lettuce tree, a close relative of the cotton plant. Upon the surface of the capsular fruit of this plant the scale can be seen with the naked eye. The left-hand figure in the top row of our plate shows a side view of a scale magnified one hundred and sixty times, and below it in the bottom line is one seen from above. With the aid of a lens many of the scales, but of a smaller size than on the capsule, can be found upon the under side of the leaf stalk, just where the leaf lamina comes off. Upon the under side of the leaf, at the points where the veins diverge from the stalk, there are many small pits. These are situated at the origin of the veins, one pit being in the angle between every two main veins. Within these pits the whole epidermis is covered with the minute peltate scales. The scales also abound on the lower surface of the petals. When examined under the microscope each scale is seen to consist of a large number of fused hair-like units or cells. These scales would seem to have functioned originally in the water economy of the plant. The scale as such in its complete form is not common on many of the Malvaceæ. On *Thespesia macrophylla*, a species

closely related to *T. populnea*, neither this umbrella-like scale, nor any vestige of it, appears to be present.

On *Hibiscus rosa-sinensis* (the China Rose) the scale exists as a minute organ on the surface of the anthers, where it can be seen only under the microscope.

There is reason for believing that the presence and absence of this scale, with regard to different species of plants, constitute a pair of factors behaving in a regular form of Mendelian inheritance.

Another epidermal organ, besides the peltate scale, found on plants of the Malvaceæ, Bombaceæ, and Sterculiaceæ, is the tufted, or stellate, hair group. This consists of several hairs, quite free from one another except at the lower end, where they arise as a group from a common point in the epidermis.

From both the peltate scale and the stellate hair group single hair units have separated. From the former, which is of especial interest to us, have come the lint and fuzz hairs of cotton, in a way that we shall see presently. The stellate hair group has given rise to most of the single hairs that clothe the parts of so many plants of the three families.

The constituent cells of young peltate scales have thin primary walls, but as the scales grow older these cells greatly thicken their walls by the daily deposition of a shell of cellulose secreted by the protoplasm on its outer surface within the already existing wall. As a result of this method of growth in thickness the walls of old cells have a laminated appearance. In the party-walls of neighbouring cells pits exist in the secondarily-deposited layer (but not in the first or primary wall). These pits are due to the non-deposition of cellulose at various places. At these pits the protoplasmic contents of two neighbouring cells will be separated by primary wall only.

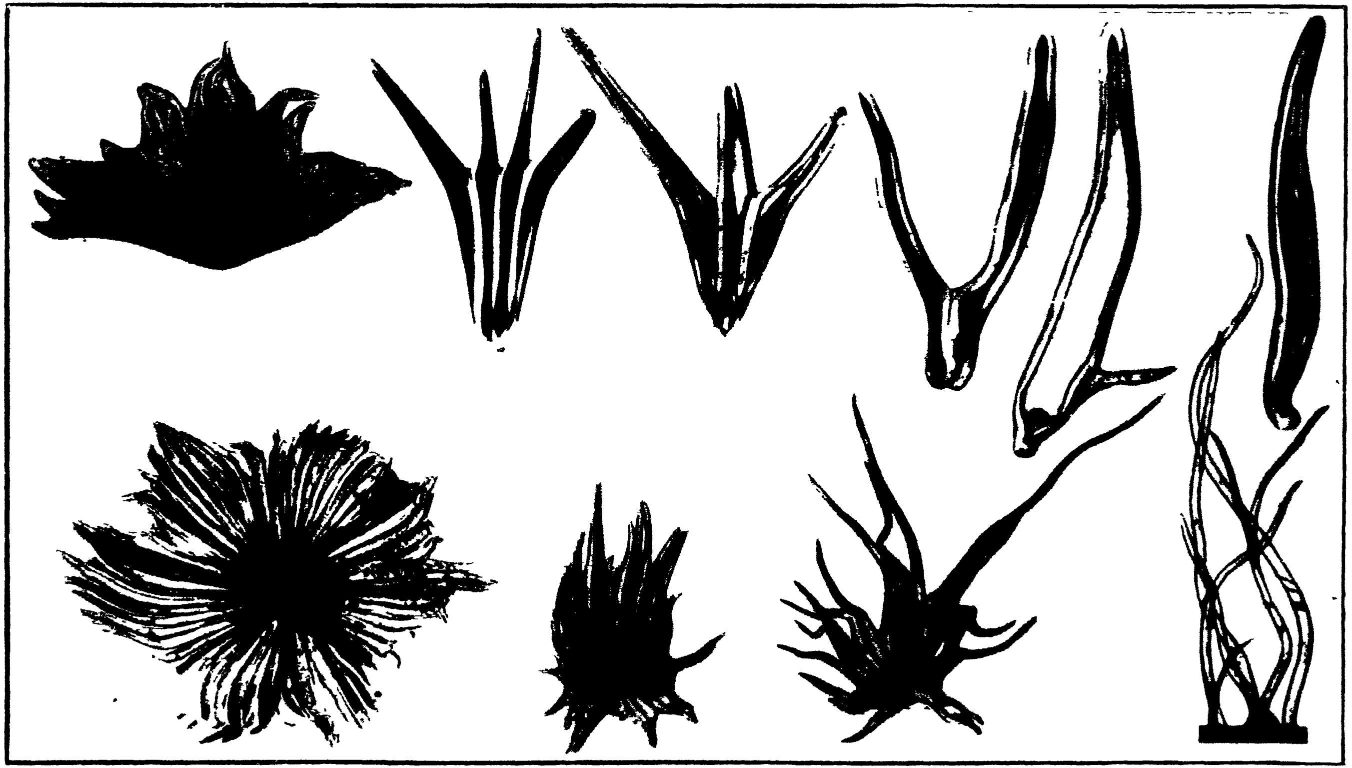
The multicellular umbrella-like scales, when they occur between two surfaces—as is the case with those on the lower side of a petal, between it and the calyx—exhibit a tendency for their individual cells to separate one from another. The fundamental factor effecting this separation is the sun's radiation. The peltate scale loses its concentric arrangement and becomes shield-shaped (second figure from the left in the bottom line of our plate), owing to the constituent cells on one side elongating toward the light. As the cells grow in length they separate from one another until they become a tuft of solitary hairs (the two figures on the right in the bottom line of our plate).

Each day each hair has a torsional force directed upon it, causing it to twist. This is shown in the frequent entwining of the hairs with

one another in a very regular manner. This torsional force, due to the movement of the sun, causes the individual concentric laminæ or shells of cellulose in the secondary wall of the hair to slip or shear upon one another so that the pits no longer track. The result is that the pits, instead of being open hole-like cavities extending from the protoplasm outward through the secondary wall to the primary wall (which they do not perforate), now become a series of closed cavities at different depths within the secondary wall. A good idea of what happens during this shearing can be gathered by comparing the secondary wall of a growing hair to a pack of cards with a hole cut through them all. This hole would represent the condition of the pit in a young cell wall with but few concentric layers. The shape of the pit in surface view is bi-concave. Now if the cards in our comparison be slipped upon one another, so that their edges are no longer vertically over one another, we have a representation of what happens on shearing. Instead of a continuous pit there results a series of cavities in individual cards embedded at different depths in the pack. From this analogy it is easy to understand why the pits are usually only to be seen in the cell wall of a young hair before shearing has taken place. Within the fruit capsule of *Eriolæna quinque-locularis*, one of the Sterculiaceæ, there are hairs whose laminæ shear but little, and in which the pits persist as continuous canals through all the laminæ of the secondary wall.

A lint hair of cotton, it would thus appear, probably arose originally, in the history of the race of lint hairs, from a peltate scale as seen on a petal by the separation from this peltate scale of its constituent cell units, before they had thickened their walls. Later the single hairs or cells so derived became occluded within the capsule. This occlusion took place in the evolution of the capsular fruit from a schizocarpic one, such as that seen today in the Mallow. The schizocarpic fruit in its turn was derived from a cluster of monocarpellary fruits, such as is found today in some primitive genera of the Malvaceæ. Evidence of this entry of the hairs into the capsule in its phylogeny is afforded by the presence of hairs on the inside of the capsule wall in many cottons and other related plants.

It may be emphasized for the guidance of those who may not be familiar with the working of evolutionary processes in organisms, that each individual cotton hair does not today arise on the petal step by step from a peltate scale as here described, but that it was in this way that the single hair arose in the past history of its race. Today it appears from the first as a single hair and within the capsule, but it bears in its structure the pits and other signs of the line along



THESPESIA POPULNEA.

The top line, from left to right, shows the evolution of a "fuzz" hair. The bottom line shows the development of a "lint" hair upon the petal. Photomicrographs. ×160

which developed the whole race of lint hairs. In this way the development of the individual reveals stages in the history of the race.

Once within the capsule the lint hairs appear to have spread to the seed coat, where they found a habitat specially suited to growth in length.

The evolution of the fuzz hair, also from a peltate scale, is very well seen on making a study of the hairs upon the seed coat of *Thespesia populnea*. Here will be found many peltate scales, but they are of a reduced form of the many-celled ones found on external surfaces. Types with four fused cells are common. In the top line of our plate on the extreme left is a side view of a mature peltate scale from the petal, next to it on the right is one from the seed showing four cell units, and further right again is one of three cells. As we progress further right the figures show the evolution to a single hair. Thick-walled, mature peltate scales entered the capsule in the same way, and at the same time in past history as did the solitary lint hairs. The evolution of a fuzz hair from a peltate scale has taken place within the capsule. This is an important distinction between a fuzz hair and a lint hair. Another important distinction between the two is that the fuzz hair appears to have isolated itself within the capsule from an already thick-walled peltate scale, whilst on the other hand the lint hair appears to have entered the capsule in a thin-walled condition. This means that in their ontogenies a fuzz hair increases in wall thickness before it has any chance to increase in length, whilst the lint hair increases in length before it thickens its wall. This delay in the thickening of the wall represents the period in the past life-history of the lint hair during which its ancestors passed through a stage of fused units in a shield-like plate.

In addition to peltate scales and hairs derived from them, the stellate hair groups also seem to have found their way into the capsule. Cottons generally are distinguished by having the derivatives from the peltate scales as the predominating hairs within the capsule. Upon the seed coat of almost all types of cotton, however, some hairs derived from a stellate hair group can be found, but usually they are rare. Upon the very coarse linted Asiatic cottons, *Gossypium cernuum* from Assam and *G. neglectum var. roseum* (which in consequence of its high ginning ratio is in India an impediment to the spread of cottons with better lint), the number of hairs derived from stellate hair groups is comparatively large. It is large enough to raise the " ginning percentage " of these cottons some five to ten per cent. above that usually found amongst other Asiatic varieties. There is probably

some close genetic connection between these two cottons which explains why they have this character in common.

In *Thespesia populnea* the peltate scale in a reduced form, and single-celled hairs derived from it, are the common outgrowths on the fuzzy seed coat; whilst in *Thespesia macrophylla* a few stellate hair groups are found on the tip of what is otherwise a naked seed.

The peltate scale derivatives, the lint and fuzz, behave genetically as independently inherited organs. One may be present without the other.

The peltate scales and stellate hair groups are also quite independent of one another in inheritance.

Glabrous types of cotton without any stellate hairs on their epidermis are known. The Egyptian "Hindi Weed" would seem to represent this phenomenon.

The complex nature of the ginning percentage factor will now be understood. The number of the longer hairs, generally classed as lint, upon the seed coat, is governed by two important factors—firstly, by the number of such longer hairs phylogenetically derived from stellate hair groups (they might be known as "false lint"), and, secondly, by the number of hairs derived through a peltate scale ancestry ("true lint"). It is incorrect therefore to assume, as has been done by some, that ginning percentage behaves as a single factor in inheritance. In most cottons the lint does consist predominantly of peltate scale hairs, but one must not generalize on the assumption that they are entirely such.

Received December, 1929.

NOTES ON CERTAIN FACTS ON VICINISM AND ARTIFICIAL POLLINATION IN EGYPT

BY

T. TROUGHT,

Cotton Research Botanist, Lyallpur

(Late Senior Botanist, Ministry of Agriculture, Cairo).

THE following hitherto unpublished notes on some experiments connected with the subject of vicinism, which were carried out in Egypt during the years 1921–24, may be of interest to those engaged in the propagation of pure cotton seed, and should be read in conjunction with Abstracts 120 and 122 in this number.—[ED.]

INTRODUCTION.

In 1921 an experiment was carried out with the primary object of obtaining a figure which could be used, in practice, for the width of belt which should be discarded from propagation plots of pure seed, when these plots were adjacent to other plots of different varieties of cotton. It was also expected that information might be obtained on the period when natural crossing in the field reaches its maximum, so that at picking time, by a suitable arrangement of picking dates, the bolls set during this period could be excluded from the seed cotton destined to provide seed for further propagation.

DESIGN OF EXPERIMENT.

A circular clump of Pure Line Red Leaf cotton was grown in the centre of a field of Sakel. Sixteen radii from the centre of the field, corresponding to the sixteen chief compass points, were marked out, and the Sakel plants on these lines were labelled. A scale plan of each radius was plotted, showing the exact distance of each hole from the centre of the plot. Each plant was picked separately at weekly intervals starting from August 2. The seed from these holes was sown in 1922, keeping the different holes and different pickings separate, and the numbers of Red Leaf hybrids were recorded. The sowing was delayed till May in order to obtain as high a germination as possible on a field scale. The actual percentage of germination was 73·3 per cent.

In 1922 a considerable number of artificial pollinations were made at different times of the morning on to both emasculated and un-

emasculated flowers. Dr. Lawrence Balls had pointed out that in the field the figures of cross pollination obtained might be vitiated by the pre-potency of Sakel pollen over the Red Leaf pollen.

The figures obtained from these pollinations led to a further series of pollinations being made in 1924. The tables below give the results obtained up till the time the author left Egypt.

Counts on Seedlings in 1922.

The total number of seedlings which germinated was 37,756, of which 37, or 0·1 per cent., were Red Leaf crosses. The greatest distance at which crossing took place was 20 metres from the nearest Red Leaf plant. The percentage of crossed seeds at different distances from the nearest Red Leaf plant is shown in Table I. below, and graphically in Fig. 1. The percentage is of all seeds which germinated from radial plants within the distances mentioned.

It must not be forgotten that the actual amount of crossing which takes place on an individual plant is not represented by the amount of Red Leaf hybridism shown, but is considerably more. Thus, suppose that, instead of a circular clump of cotton in the centre of the field, the Red Leaf cotton had been planted on the arc of a circle of 2 metres radius, subtending an angle of 60° at the centre. It is, probably, legitimate to suggest that a Sakel plant at the centre of that circle would, if the circle of Red Leaf plants had been complete, show some six times the number of vicinists it would show when only one-sixth of the circumference was Red Leaf. It might also be expected that each successively wider circle of plants would affect a plant at their centre in a diminishing degree. Brown* gives an example of a single plant in the centre of a field of a different type which showed over 50 per cent. of vicinists in its progeny.

The actual figures of Red Leaf vicinists in this experiment cannot then be considered as indicating the total amount of natural crossing which goes on in the field. The figures indicate, however, that crossing is probably greater than the 5 to 10 per cent. usually postulated; though, with the particular layout of this experiment, it appears that the mathematics required to calculate from the figures obtained, the effect on a single Sakel plant in a Red Leaf field, would be complicated. Also the question of the "pre-potency" of the pollen of the Egyptian type over the Red Leaf type cannot be ignored, as is shown later; the amount of crossing of an Egyptian type on to an Egyptian type would be greater than that recorded for an Upland type on to an Egyptian type.

* H. B. Brown, "Cotton," p. 166 (McGraw-Hill Book Co., New York).

Cases of crossing at greater distance than 20 metres have been recorded. Balls* gives an example of crossing at over 50 metres; Brown† says there may be crossing between fields a quarter or half a mile apart. For practical purposes, however, it was decided that 20-metre belts should be discarded at the boundaries of propagation plots.

Artificial Pollination in 1922 and 1924.

Tables II. to IV. give details of the crosses made and the results from the counts of germinated seedlings in 1923 and 1925. A mixture of Red Leaf and Sakel pollen was applied to the Sakel stigmas at different times during the morning. It will be seen that in 1922 between 11 a.m. and noon there was a considerable reduction in the percentage of hybrids produced. The 1924 pollinations show, however, that this reduction is apparently unreal. Sakel pollen applied to "Wrinkled Leaf Dwarf" flowers (see *Report for* 1923, *Cotton Research Board, Giza*, p. 15) did not give reliable results. The results from 1924 pollinations show considerable differences in the percentage of hybrids obtained from July 8 to 10, compared with those obtained from July 24 to 26. There appears to be no reason for these differences unless Red Leaf pollen, which came from flowers produced at the tail-end of the Red Leaf flowering flush, was less viable than pollen from earlier flowers.

These figures confirm the conclusion of Balls* and Kearney† that the Egyptian type of pollen on an Egyptian style is pre-potent over the Upland type.

Date of Maximum Crossing.

This is shown diagrammatically in Fig. 2, together with the percentage of total germinations obtained at each picking date. The possibility of arranging pickings to avoid vicinism does not seem to be practicable.

Conclusion.

The experiment shows that in the particular year 1921 at Giza the observed percentage of crossed ovules in a field crop—even though it may be considerably lower than the total crossing which occurred—was still sufficiently high to be a seriously detrimental factor in the propagation of pure strains into bulk. Adequate belting, even on large plots, means a serious loss of seed. It therefore emphasizes the

* W. L. Balls, "The Cotton Plant in Egypt," p. 121 (Macmillan and Co., London).

† T. H. Kearney, "Self-fertilization and Cross-fertilization in Pima Cotton" (U.S.D.A. *Bull. No.* 1134, p. 48).

importance, as noted by Brown,* of "one variety communities" for the maintenance of a pure bulk crop; and the necessity in those districts where "one variety communities" cannot yet be introduced, of Leake's† "Wave System" for the propagation and distribution of pure seed.

[It is clear that various factors have to be considered, and that a large and somewhat complicated experiment would be necessary to obtain definite figures.—Ed.]

TABLE I.—SHOWING DECREASE IN PERCENTAGE HYBRIDS OBTAINED WITH INCREASE IN DISTANCE.

Distance in metres from nearest Red Leaf plant ..	2	4	5	7	10	22
Percentage of hybrid ovules	0·87	0·53	0·41	0·31	0·21	0·10

TABLE II.—SHOWING RESULTS OF ARTIFICIAL POLLINATIONS PERFORMED IN 1922, WITHOUT PREVIOUS EMASCULATION.

Time of Pollination ..	8 to 9 a.m.	9 to 10 a.m.	10 to 11 a.m.	11 to Noon	Noon to 1 p.m.	Red Leaf Sakel pollen applied simultaneously.
Percentage of hybrids obtained	31·5	34·1	39·5	13·7	44·0	—
Total seedlings germinated	140	170	190	102	150	—

TABLE III.—SHOWING THE RESULTS OF ARTIFICIAL POLLINATIONS PERFORMED IN 1922, ON FLOWERS PREVIOUSLY EMASCULATED.

Flowers Pollinated.	*Mixture of Pollen Applied.*	*No. of Seedlings*	*Percentage Hybrids.*
Sakel	Red Leaf and Sakel together	84	35·7
"	F^1 of Sakel × Red Leaf and Sakel together	62	8·1
Wrinkled Leaf Dwarf	Wrinkled Leaf and Sakel together	7	85·7
" "	Sakel and then Wrinkled Leaf after 1 hour	16	81·25
" "	Sakel and then Wrinkled Leaf after 2 hours	17	94·1
" "	Sakel and then Wrinkled Leaf after 2½ hours	65	87·7
Sakel	Red Leaf and then Sakel after 2 hours	16	62·5

* H. B. Brown, *loc. cit.*

† H. M. Leake, "Report on the Maintenance and Improvement of the Quality of Egyptian Cotton" (Cairo Government Press, 1920).

TABLE IV.—SHOWING THE RESULTS OF ARTIFICIAL POLLINATIONS DONE IN 1924, WITHOUT PREVIOUS EMASCULATION.

Date of Pollination.	Time of Pollination.	7.30 a.m.	8.30 a.m.	9.30 a.m.	10.30 a.m.	11.30 a.m.	12.30 p.m.	1.30 p.m.
8/7/24	Percentage of Hybrids	0·95	16·0	13·1	36·2	3·9	12·1	12·7
9/7/24		23·0	27·6	30·3	13·1	22·5	7·4	16·0
10/7/24		25·7	24·9	31·2	18·2	29·7	22·3	13·8
Average		16·6	22·8	24·9	22·5	18·7	13·9	14·2
24/7/24	Percentage of Hybrids	5·7	4·0	1·6	4·4	5·6	4·2	2·5
25/7/24		8·6	6·6	6·6	0·9	5·2	3·9	16·0
26/7/24		1·7	2·7	2·1	3·0	5·5	5·8	0·0
Average		5·3	4·4	3·4	2·8	5·4	4·6	6·2

GIZA 1921

DIAGRAM SHOWING PERCENTAGE VICINISM.

AT DIFFERENT DISTANCES.

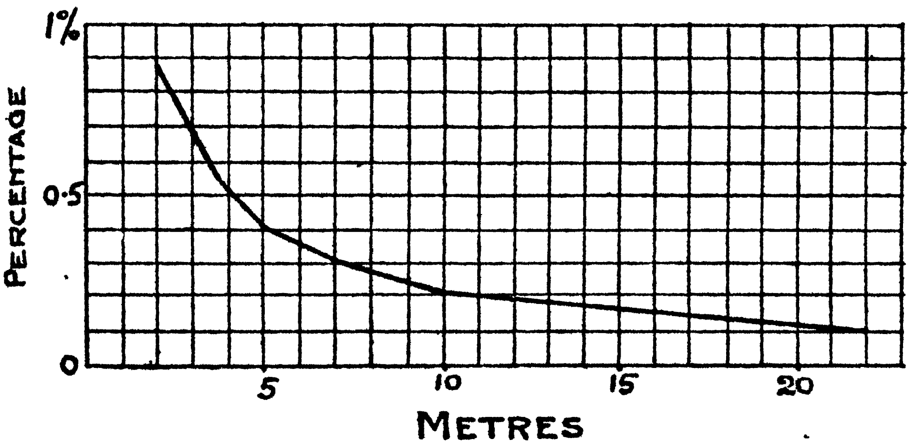


FIG. I.

GIZA. 1921

DIAGRAM SHOWING NUMBER OF VICINISTS IN DIFFERENT PICKINGS (CONTINUOUS LINE) AND PERCENTAGE OF TOTAL CROP (WHICH GERMINATED) FROM EACH PICKING IN 1922 (BROKEN LINE)

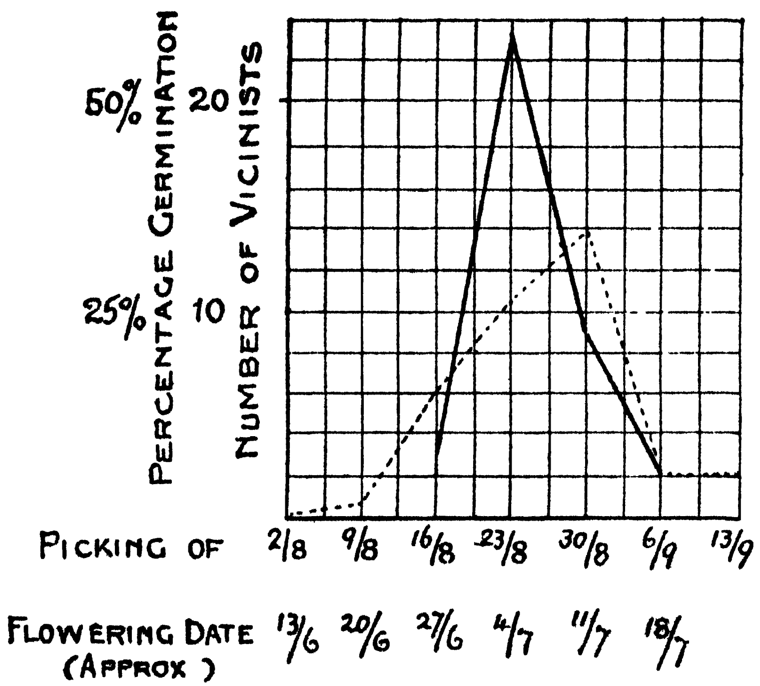


FIG. II.

Received September, 1929.

THE DETERMINATION OF FINENESS OF EGYPTIAN COTTON AND ITS RELATION TO QUALITY

BY

N. W. BARRITT, M.A.,

Rothamsted Experiment Station; late Cotton Research Board, Egypt.

Of the various properties of Egyptian cotton, its length and fineness are the most obvious. In recent years much attention has been given to other characters, such as strength, rigidity, and convolutions, but length and fineness still remain the dominant features of cotton. Either of these two properties may be used as a basis for classifying the world's cottons, and the same result is obtained in each case, because in a general way length and fineness are correlated.

Length, being the more obvious character of the two, and apparently (but not actually) easier to measure,* has consequently been the chief character used in selection work for improvement in quality, fineness being allowed to take care of itself. There is no doubt that this method of selection has resulted in considerable improvements in the shorter-stapled cottons of America and India, but among fine cottons this method has given disappointing results. Recent work in Egypt has shown that an increase in staple length alone is not sufficient to effect an improvement in quality. And further, maintaining the staple length of a variety by rogueing does not necessarily result in maintaining its spinning quality from year to year. The correlation between length and fineness which appears to hold for a general survey of the world's cotton does not hold for the strains of any one variety.

The question of how to estimate fineness, independently of length, is therefore a very important one. Graders who deal only with fine cottons acquire a most remarkable skill in this respect, so much so that they can readily distinguish between samples of the same variety of cotton grown in different localities less than fifty miles apart. The cotton breeder requires methods that will enable him to compete with the grader in this respect, and what is more, such methods as can be applied to the product of a single seed.

* Dischendorfer, O., *Angew. Botanik*, 1925, p. 57.

I.—Hair Weight per Cm.

In the cotton trade the fineness of yarn is measured in the same way as engineers measure wire and metal rods—*i.e.*, as length per unit weight. The reciprocal of this is weight per unit length, and is applicable to material of short variable length like cotton lint. Balls[1] introduced this unit of measurement to express the fineness of cotton hairs. Morton[2] used it as a basis for classifying and even identifying the whole range of cottons used in the industry. In a general way it is a useful measure of fineness especially to the spinner, but when applied to particular cases it is often misleading. If cotton hairs were of uniform cross-section, like copper wire, the hair weight per cm. would be a reliable indication of the physical properties of the hair. But unfortunately they consist of collapsed tubes of varying diameters and wall thickness, and the hair weight measures the average amount of cellulose per unit length of hair, and tells us nothing concerning the all-important distribution of this cellulose about the axis of the hair. A coarse cotton with thin walls may have the same hair weight as a fine cotton with thick walls, and the same pure line of cotton grown in different localities may have very different hair weights. Such a standard of fineness must necessarily lead to confusion in cotton breeding. The results in Table I. from one pure line of Sakel cotton grown in six different localities in the Egyptian Delta serve to illustrate this point.

TABLE I.

No. of Sample.	*Hair Weight per Cm.*	*Hair Strength.*	*Yarn Strength.*	*Percentage Spinning Waste.*
1	157	3·9	1,927	21·6
2	151	4·0	1,998	20·8
3	146	4·1	1,989	20·5
4	141	4·0	2,019	22·6
5	139	3·9	2,067	23·9
6	134	3·6	1,913	25·7

From the standpoint of hair weights these six samples might have represented six different strains of cotton, No. 6 approaching Sea Island, and No. 1 a cotton like Pelion in hair weight. The figures of the spinning tests are included for comparison, and it is interesting to note the apparent correlation between hair weight and waste. Evidently in this case fineness, as expressed by hair weight, is not a measure of quality in cotton. These yarn tests are also interesting as showing considerable differences for the same strain, and hence

they have a very limited application in cotton breeding. Too much importance is often attached to strength tests, and too little to the measurable characters of the hairs themselves.

The relation between hair weight and waste is also shown in Table II., giving the results of tests on six different strains of Sakel cotton grown in the same locality.

TABLE II.

No. of Sample.	*Hair Weight per Cm.*	*Hair Strength.*	*Yarn Strength.*	*Percentage Waste.*
7	159	4·1	2,141	19·0
8	155	4·7	2,284	21·2
9	146	4·3	1,940	23·1
10	145	4·4	2,207	22·9
11	141	4·0	2,002	24·0
12	137	3·6	1,766	26·1

Taking the whole twelve results together the correlation coefficient between hair weight and percentage waste works out at $-\cdot 87$, which is very significant. It must be concluded, therefore, that among strains of long staple cottons the hair weight is correlated with the percentage waste produced in spinning.

In addition to immature hairs (low hair weight) spinning waste also contains short thick hairs. It must not, therefore, be assumed that this correlation will hold for all types of cotton, but only for those in which length of staple is more or less uniform, as in the case of the above twelve strains of Sakel. It is interesting to note that Samples 2 and 7 with high hair weights and low waste were grown in the middle Delta region noted for its production of high quality Sakel, whereas Samples 6 and 12 with low hair weights and high waste were grown near Cairo, which is generally considered unsuitable for this type of cotton. This suggests an interesting problem for the cotton breeder to find a strain of Sakel capable of giving a higher hair weight per cm. in the Cairo district without loss of staple or increase in diameter.

It is one of the mysteries of cotton-growing that the wall thickness of lint hairs is greater in one district than in another only fifty miles away, though the growth of the plants in both places is quite normal to all appearances. The present writer[3] has recently shown that the growth of the hairs is dependent on the intercellular sap which escapes through the stomatal pores of the seed coat. The developing seed is able to satisfy its own requirements first, and only the surplus goes

to the production of cotton cellulose. The precise conditions determining this flow of sap have not yet been discovered, but it is known to be largely dependent on climatic conditions. The longer nights and lower day temperatures of the autumn appear to increase this flow, so that cotton maturing late has a higher weight per cm. than early maturing cotton.

Probably the more desert climate of Cairo has a less favourable influence on the nutrition of the hairs than the more temperate region nearer the sea, and similarly the winter climate of the Sudan may account for the higher hair weight of Sudan Sakel over Egyptian Sakel, though there is some evidence that change of diameter is also concerned in this case. Summers[4] also found that ratoon cotton, which matures earlier, has a lower hair weight than annual cotton of the same variety.

II.—The Diameter of Cotton Hairs.

It is reasonable to suppose that the dimensions (length and breadth) of cotton hairs would be subject to less variation due to cultivation than the wall thickness and hair weight. At least, it is found to be so in a comparatively small tract like the Egyptian Delta. As the writer has pointed out elsewhere in this Journal,[5] an increase in diameter would infer a change in genetic constitution of the plant.

The measurement of diameter, unfortunately, is considered to be a matter of considerable difficulty owing to the irregular collapse of the hairs on drying. Measurement of the diameter of the uncollapsed hair[6] is a simple matter and constitutes a reliable basis for individual selection for fineness, since, whatever may be the amount of subsequent thickening of the cell wall, the resulting cotton must be classed as fine or coarse, according to its diameter before collapse. But it is not convenient to apply this method to the measurement of a crop, owing to the large number of individuals required to obtain a truly representative sample. Correct sampling is of fundamental importance in all measurements of cotton hairs. Adjacent hairs grow together with a similar conformation, and tend to remain together as tufts which often present considerable difficulty in dispersal. With dried cotton this is best effected by carding the material before sampling.

Two systems of measurement of collapsed hairs have been suggested—viz., ribbon width and mercerized diameter. Ribbon width is the measurement of the broadest part of the convolution and obviously gives a higher reading than the true diameter. Turner,[7] working with Indian cottons, found it to be of equal importance to

fibre length in determining yarn properties, and of greater significance than hair weight or hair strength. As a measurement of fineness it is open to the objection that thin-walled or immature hairs will give a higher value, and therefore appear coarser than thick-walled hairs.

The measurement of mercerized diameter was introduced by Clegg and Harland[8] as having a more reliable basis than ribbon width. The mercerization process consists in swelling the hairs in 18 per cent. caustic soda solution, washing in water, and drying. By this treatment the hairs assume a more even cross-section. The diameter measurements obtained in this way should be more significant than ribbon width measurements, but it should be remembered that there is no treatment capable of converting the ribbon-like thin-walled hairs into thick-walled hairs of even cross-section. The presence of thin-walled hairs is the source of a positive error in both the above methods, and it is therefore a legitimate procedure to omit them from measurement. With a correctly made sample 300 measurements will give a result accurate to ±2 per cent., and by using a projection microscope, with critical illumination and a magnification of 1,200 to 1,300, this number of measurements can be recorded without difficulty in about one hour. The diameter measurement is therefore one of the simplest and most accurate determinations possible with cotton hairs.

The writer determined the mercerized diameter of several varieties of Egyptian cotton grown in duplicate in different districts. The results are given in Table III. along with those of three samples grown in Spain and the Sudan.

TABLE III.

DIAMETER MEASUREMENTS IN $\frac{1}{1000}$ MM.

Variety.				
	Upper Egypt.	*Giza.*	*Spain.*	
Ashmuni 1	19·5	19·7	—	
„ 2	20·1	20·6	—	
Zagora	19·8	20·1	20·3	
	N. Delta.	*Mid-Delta.*	*Spain.*	*Sudan.*
Sakel domains	17·4	17·1	17·4	18·5
Sakel 1	15·8	15·6	—	—
„ 2	16·3	16·5	—	—
„ 3	17·1	16·8	—	—
„ 4	17·0	17·1	—	—

The results obtained from the same cotton in two different districts in Egypt agree within experimental error. Two of the same cottons

grown in Spain agree with the results obtained in Egypt, but the sample of Domains Sakel grown in the Sudan has a greater diameter than the same cotton grown in Egypt and Spain. From these results it is reasonable to suppose that the summer climate in the valley of the Guadalquivir more closely resembles that of the Egyptian Delta than does the winter climate of the Sudan.

The frequency curves of diameter measurements for different types of cotton are shown in Fig. 1.

From these curves it will be seen that the finest cotton (Sea Island) has the lowest dispersion of diameter measurement—in other words, fineness is correlated with uniformity and coarseness with variability.

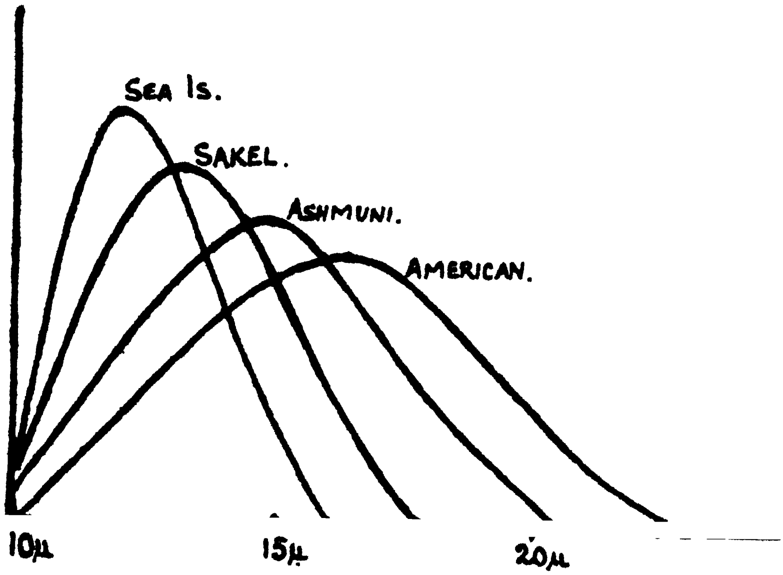


FIG. 1. FREQUENCY CURVES OF DIAMETER.

If we compare these curves with those obtained by the Sledge Sorter for the same types of cotton we find the order of dispersion is reversed (see Fig. 2).

Sea Island cotton shows the greatest variability in staple, whilst American shows the least. Herein lies the greater importance of fineness in cotton compared with staple. Selection for fineness results in a cotton of greater uniformity, whereas selection for staple alone increases variability. Further, hairs of small diameter have a greater surface area per unit weight than coarse hairs, and have therefore an advantage in nutrition and are less likely to remain thin-walled or neppy. The uniformity thus extends also to wall thickness as well as diameter, and probably accounts to some extent for the greater intrinsic strength of fine hairs.[9] It follows therefore

that the most effective way of improving a short staple cotton is to make selections from it on the basis of diameter rather than length of fibre. The possibilities of the improvement of cottons from this standpoint are as yet unexplored, but an interesting example is afforded by the cotton known as Nahda. This cotton has the same staple as Zagora combined with the diameter of the finest Sakel. Though it thus stands in a class by itself, it immediately received the eulogy of the spinners for its high quality and resemblance to their long lost but never forgotten Yannovitch.

Another interesting cotton illustrating this point is the new cotton known as Maarad,[10] now being extensively grown in the Delta. This cotton was selected for high yield, length of staple, and fuzziness of

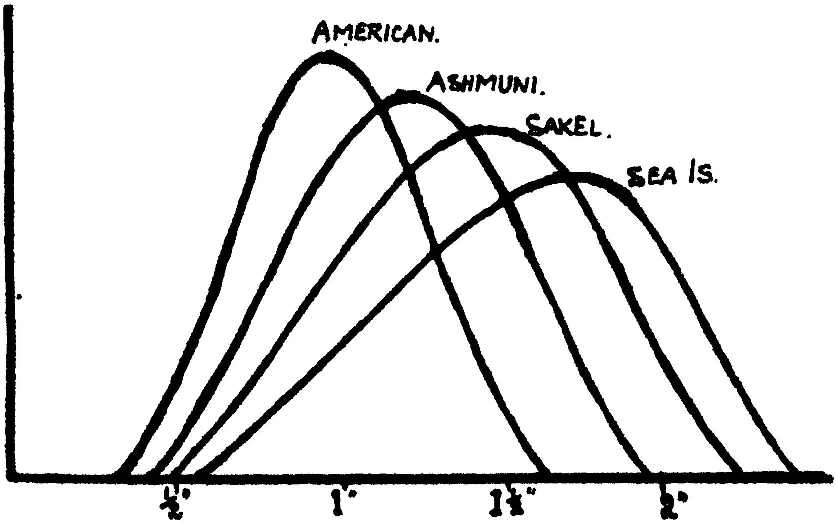


FIG. 2. FREQUENCY CURVES OF LENGTH.

seed, and in all these respects it is superior to Sakel, but from the spinners' point of view it has been disappointing. The increase in staple is apparently not appreciated by the spinner, the fuzz is of no use to anyone, and were it not for the 10 per cent. to 15 per cent. increase in yield there is little doubt that this cotton would occupy a very limited area or soon pass out of cultivation altogether.

For similar reasons the present attempts[11] to replace Ashmuni cotton in Upper Egypt by long staple types are of doubtful economic value. The result will probably be an over-production of long staple cottons with no benefit to the grower and of doubtful value to the spinner. The most promising improvement in Uppers cotton would appear to be in the direction of fineness rather than staple. In this way it would be removed from the increasing competition of long staple American without endangering the position of Sakel.

III.—The Mean Ribbon Width

In the measurement of diameter it is not always easy to judge if the particular portion of the hair under observation is typical of that hair or only an abnormal portion. This, and the omission of thin-walled hairs from measurement, is liable to give rise to a subjective error. To overcome this the writer was led to try the measurement of every hair in two separate places, one being at the flat portion of the convolution (Fig. 3, A), and the other at the region of twist or "edge-on" position (B).

It can be shown that the mean of these two measurements approximates more or less closely to that of the mercerized diameter, according to the amount of secondary thickening of the hair. Suppose a normally thickened hair to have a mercerized diameter of 14μ. Such

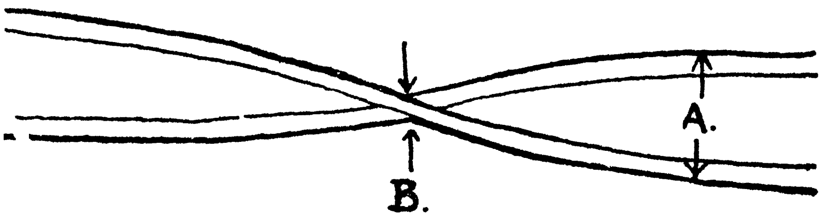


Fig. 3. Convolution of Unripe Hair.

a hair before wall thickening had begun would collapse to a ribbon whose widest diameter would be half the perimeter—viz., $\frac{\pi \times 14}{2}$, or 22μ. The width of the "edge-on" position (B) would be, say, 2μ. The mean of these two measurements gives 12μ as the "mean" ribbon width, and this figure represents the maximum deviation from the true diameter shown by immature hairs. Thus, if all the hairs of a sample were unthickened, the reduction in the measurement of mean ribbon width could not exceed 14 per cent., whereas if, say, only one-tenth of the hairs were immature, the deviation of the mean ribbon width would be less than 2 per cent. By this system of double measurement of each hair we reduce the disturbing effect of immature and abnormal hairs to a minimum. By any other system of measurement the effect of immature hairs is to increase the mean diameter, and to a much greater extent. This is a much more serious error, since immature hairs do not behave as coarse hairs during spinning.

Another useful feature of these diameter measurements is the

degree of dispersion of the measurements about the mean value. The two extreme measurements cause a considerable increase in the dispersion due to immature hairs, so that the standard deviation of the mean becomes a useful measure of the degree of immaturity of the sample.

This method was applied to six samples of Ashmuni cotton taken from bolls at intervals of five days from the commencement of secondary thickening until the opening of the bolls. The results are given in Table IV., together with the hair weights determination of the same samples.

TABLE IV.

No. of Sample.	*Age of Boll in Days.*	*Mean Ribbon Width.*	*Standard Deviation σ^2.*	*Hair Weight per Cm.*
1	25	17·9	797	080
2	30	18·4	683	124
3	35	18·0	374	137
4	40	18·2	282	170
5	45	18·4	261	188
6	50	18·5	238	205

The results show a very definite correlation between hair weights (degree of immaturity) and the standard deviation. The figures for mean ribbon width are remarkable for their uniformity. According

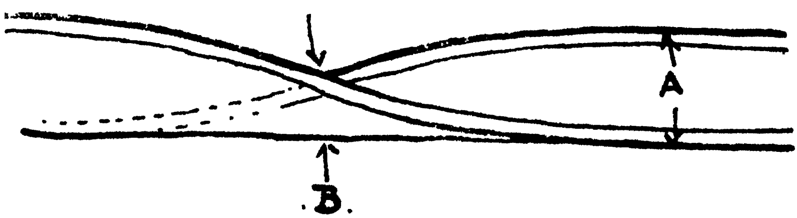


FIG. 4. FOLDED HAIR.

to expectation they ought to range from 14·3 at twenty-five days, to 18·5 at five days. This variance between observation and expectation is due to the folding of the thin-walled hairs so that the "edge-on" position (B) sometimes does not give the true measurement of wall thickness, but a much higher value dependent upon the nature of the folding (Fig. 4).

Applying this method to the six samples of the same strain grown in six different localities, we get the results given in Table V., which includes also the percentage of waste figures for comparison.

TABLE V.

No. of Sample.	*Mean Ribbon Width.*	*Standard Deviation σ^2.*	*Hair Weights per Cm.*	*Percentage Spinning Waste.*
1	15·3	154	157	21·6
2	15·7	181	151	20·8
3	15·7	173	146	20·5
4	15·6	188	141	22·6
5	15·1	181	139	23·9
6	15·2	188	134	25·7

In this case also the diameter measurements are more or less uniform, whilst the standard deviation varies inversely as the hair weights and directly as the percentage waste. As pointed out in the case of hair weights (Section I.), the correlation between waste and standard deviation of the mean ribbon width will not necessarily hold for all types of cotton, since short thick hairs as well as immature hairs occur in spinning waste.

Comparing the standard deviation figure of mature Ashmuni, Sample 6, in Table IV., with those of Sakel in Table V., we get confirmation of the statement in Section II. that coarseness implies variability and fineness implies uniformity.

IV.—Mean Ribbon Width and Lustre.

In 1924 Adderley[12] showed that the ratio of the axes of the cross-section of the hairs was correlated with the lustre of the cotton—*i.e.*, the more equal the two axes the higher the degree of lustre. He also

FIG. 5. CROSS-SECTION OF UNRIPE HAIR.

showed that the finer cottons (Sea Island and Egyptian) had more equal axes than coarse cottons (American and Indian). It will be seen from Fig. 3 that the measurements A and B represent those of the two axes of the cross-section (Fig. 5) measured by Adderley. The standard deviation of mean ribbon width is also a measure of the ratio of the two axes, and thus becomes a measure of lustre, a low standard deviation being associated with high lustre. Fineness being associated with low standard deviation is also associated with lustre. Therefore the supposed competition between artificial silk and cotton can only be met by improvements based on fineness.

SUMMARY.

1. From the botanical standpoint hair weight per cm. is a measure of the nutrition of the hairs and an indication of the neppiness or waste likely to be produced in spinning, rather than a measure of fineness.

2. Fineness is more suitably determined by diameter measurements.

3. Diameter measurements on living hairs from unripe bolls afford the most suitable basis of selection for the cotton breeder.

4. Fineness, strength, lustre, uniformity and smoothness are concomitant qualities in cotton.

5. Selection work based on diameter measurements holds out greater promise of improvement of quality than selection for staple length.

6. A modified or "mean" ribbon width method is suggested as an improved diameter measurement.

REFERENCES

1 BALLS, W. L.: "Development and Properties of Raw Cotton."
2 MORTON, J.: *J. Textile Inst.*, 1926, 17, T537.
3 BARRITT, N. W.: *Annals of Botany*, vol. xliii., No. 171, July, 1929.
4 SUMMERS, F.: *J. Textile Inst.*, 1924, 15, T543.
5 BARRITT, N. W.: EMPIRE COTTON GROWING REVIEW, Vol. I., No. 3, 1924.
6 BARRITT, N. W.: *Annals of Applied Biology*, vol. xvi., No. 3, 1929.
7 TURNER, A. J.: EMPIRE COTTON GROWING REVIEW, Vol. VI., No. 3, 1929.
8 CLEGG, G. G., AND HARLAND, S. C.: *J. Textile Inst.*, 1924, 15, T8.
9 BARRITT, N. W.: *J. Textile Inst.*, vol. xx., No. 4, T70, 1929.
10 SENNITT, R. S.: EMPIRE COTTON GROWING REVIEW, Vol. V., No. 3, 1928.
11 BALLS, W. L., AND BROWN, C. H.: *Manchester Guardian Commercial*, March, 1929.
12 ADDERLEY, A.: *J. Textile Inst.*, vol. xv., No. 2, T195-206.

Received September, 1929.

[A paper which should provoke discussion and further consideration of the important matter of breeding cotton for improvement in quality.—ED.]

THE ANGULAR LEAF SPOT OF COTTON IN EGYPT

BY

TEWFIK FAHMY

Plant Protection Section, Ministry of Agriculture, Giza, Egypt.

Occurrence.—A bacterial spot on the leaves and bracts of cotton makes its appearance in Egypt late in the season when the plants are nearly mature. In normal years it is early in August that this leaf spot starts to show on some varieties.

Symptoms.—The spot, which is more frequent on the leaves (Fig. 1) than on the bracts (Fig. 2), starts as a small water soaked spot which at this stage, under Egyptian climatic conditions, is rather difficult to find during the day when the sun is bright and the atmospheric humidity has decreased. In the early morning, however, and after a shower of rain—on the rare occasions when this occurs—the water soaked spots can be seen on young leaves when these are held to the light. They are about 1 to 2 mm. or more in diameter, and are to be found between the veins. The translucent stage, which under Egyptian conditions seems to be of short duration, is followed by the spot becoming chocolate-brown in colour. On susceptible varieties, such as Maarad and Sakha 11, the spots are more or less angular. On Sakel, which is not very susceptible under Egyptian conditions, the spots, when present, are at this stage more round than angular, and differ in this way from those of Maarad and Sakha 11. As the spot increases in size (and this refers mostly to the two last-mentioned varieties) the angular character becomes more definite (Fig. 3). The spots measure from 1 to 3 mm. and sometimes 4 mm. in diameter, or even more when adjacent spots coalesce. As the spot advances in age a definite dark margin is formed.

The central area of the spot is lighter in colour than that of the marginal tissue; with age the dried dead tissue of the spot is liable to become torn away, leaving a hole in its place.

The spots on the bracts appear later than those on the leaves. As for the boll itself, the writer has been unable, up to now, to collect a boll showing typical spots which can be distinguished with certainty from those caused through injury or insects.

Fig. 1.—Angular Leaf Spot on Maarad Cotton.

Fig. 3.—Slightly Enlarged Portion of a Leaf Attacked by the Angular Leaf-Spot.

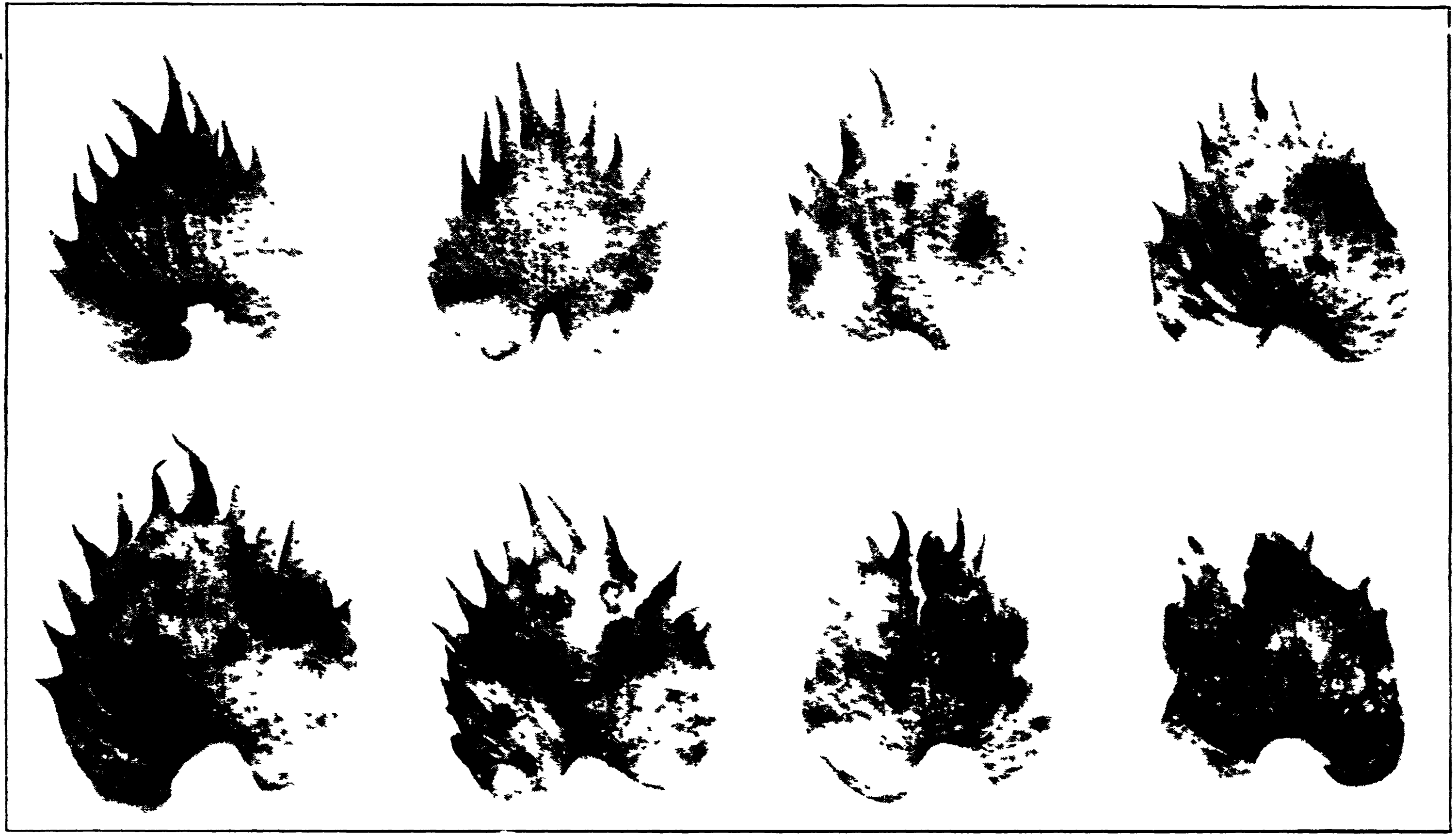


FIG. 2.—THE BACTERIAL SPOT ON THE BRACTS

FIG 4. PART OF A STEM OF A WINTER GROWN SAKEL PLANT.

Note the grey patches

Economic Importance.—This disease is so far usually of little or no economic importance in Egypt. It is indeed very doubtful if the injury it causes to the leaves of the cotton plant, being late in the season, affects the plants adversely. An interesting case, however, was observed in 1928 late in August at Sakha (North of the Delta), where on the Government Domains two new varieties of cotton, Maarad and Sakha 11, were grown for the purpose of propagation, and both varieties showed rather a severe attack of leaf spot.

It may be of interest to the reader to know that the Maarad cotton, referred to above, is an imported Pima cotton from the United States, while Sakha 11 is a selection from St. Kitts Sea Island cotton made by the Botanical Section of the Ministry of Agriculture. As a matter of fact both these varieties are very similar, with the exception that the Maarad cotton is resistant to wilt, while the Sakha 11 is completely susceptible.

Apart from the two varieties mentioned above, the cotton varieties actually grown in Egypt are resistant under local conditions when sown at the ordinary period (February to April). Several attempts, however, were made to sow cotton in August and September, with the object of establishing a plant before the winter sets in, so that in March, when the weather improves, the plants may start growing early and produce an earlier and heavier crop than that sown at the usual date.

In 1923 such an experiment was carried out at Giza. The cotton (Sakel A/22) was sown on September 6. The cotyledons showed the leaf spot. As the plants grew they were weak and shed many of their leaves after these had become covered with spots. In about the month of November the majority of the plants started to die from the tip downward. On the stem and branches ash-coloured patches were present. These were either in small isolated patches or in large areas (Fig. 4). Isolation was made from these ash-coloured patches, and among other organisms the same bacterium was obtained as the one isolated from the water soaked spots on the leaves.

Isolation.—In isolating the organism it was found better to choose a spot in the water-soaked stage rather than a brown conspicuous one, for the latter, though it yields the organism, gives many saprophytes.

The method of isolation used was the following: The part of the leaf containing the water-soaked spot was cut out with a pair of flamed scissors, after the leaf had been washed in filtered water to remove the adhering dust, etc. The cut piece of leaf was then dipped in 1/1,000 mercuric chloride for a few seconds and then washed in severa

changes of sterile water. The piece of leaf was then placed in a tube of sterile water and crushed with a sterilized glass rod. The tube was left to stand for half an hour, and from it plates were poured. Beef-agar+15 was used as a medium, and incubation was at 28 to 30° C.

The Colonies Obtained.—Three types of colonies were observed. One was of a deep yellow colour, another was orange in colour, and a third pale yellow. The latter had the following characters:

Round, 1 to 4 mm. in diameter, growing on the surface of the medium (beef-agar+15), smooth, edge entire, pale yellow, shiny, with wet surface, slightly mottled, and radiate. With age, the colony sometimes shows a pale zone at the edge.

The Organism.—The organism is very small, rod-shaped, motile, staining readily with Ziehl Carbol fuchsin, and is in chains of 2 to 4 elements, mostly two.

Infection Experiments.—Two attempts were made in 1928 to infect greenhouse-grown Sakel cotton plants, for at that period Sakel 11 and Maarad seeds were not available. The organism isolated then, though resembling that described by Erwin Smith, could not be made to produce the disease. The temperature and humidity of the greenhouse were most probably unsuitable for infection. The question was left owing to its small economic importance, and to the pressing need to investigate cotton wilt on which the writer has been solely occupied since then.

So far the only evidence for the existence of this disease in Egypt is the appearance of a leaf spot very similar to if not identical with that described by Erwin Smith. The fact remains, however, that infection experiments have not been successful. The writer is inclined to believe that the failure of his artificial inoculations is due to unsuitability of temperature and humidity during the experiment.

According to recent work the spread of the disease seems to be favoured by certain soil temperatures.

Conditions Prevalent in Egypt when the Leaf Spot Appears.

Figure 5 shows the following (10 years' average):

(1) Monthly means minimum temperature (°C).

(2) Monthly means of day temperature (°C).

(3) Monthly means maximum temperature (°C).

(4) Monthly mean reading in metres of the Nile Gauge at Roda (near Giza).

(5) Monthly means relative humidity (per cent.).

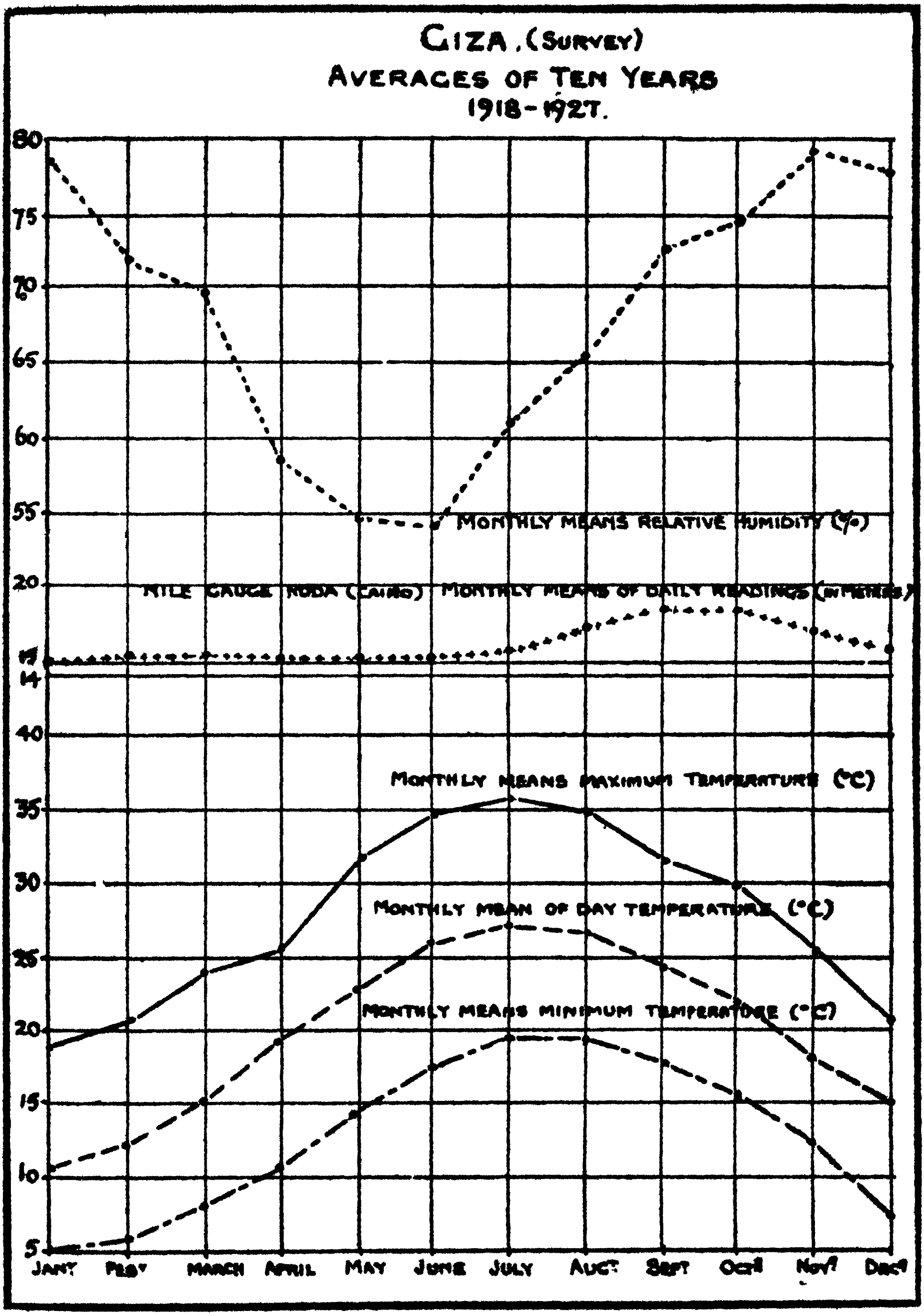


FIG. 5.

Monthly means relative humidity per cent.
Nile Gauge Roda: monthly means of daily readings (in metres).
Monthly means maximum temperature °C.
Monthly means-of-day temperature °C.
Monthly means minimum temperature °C.

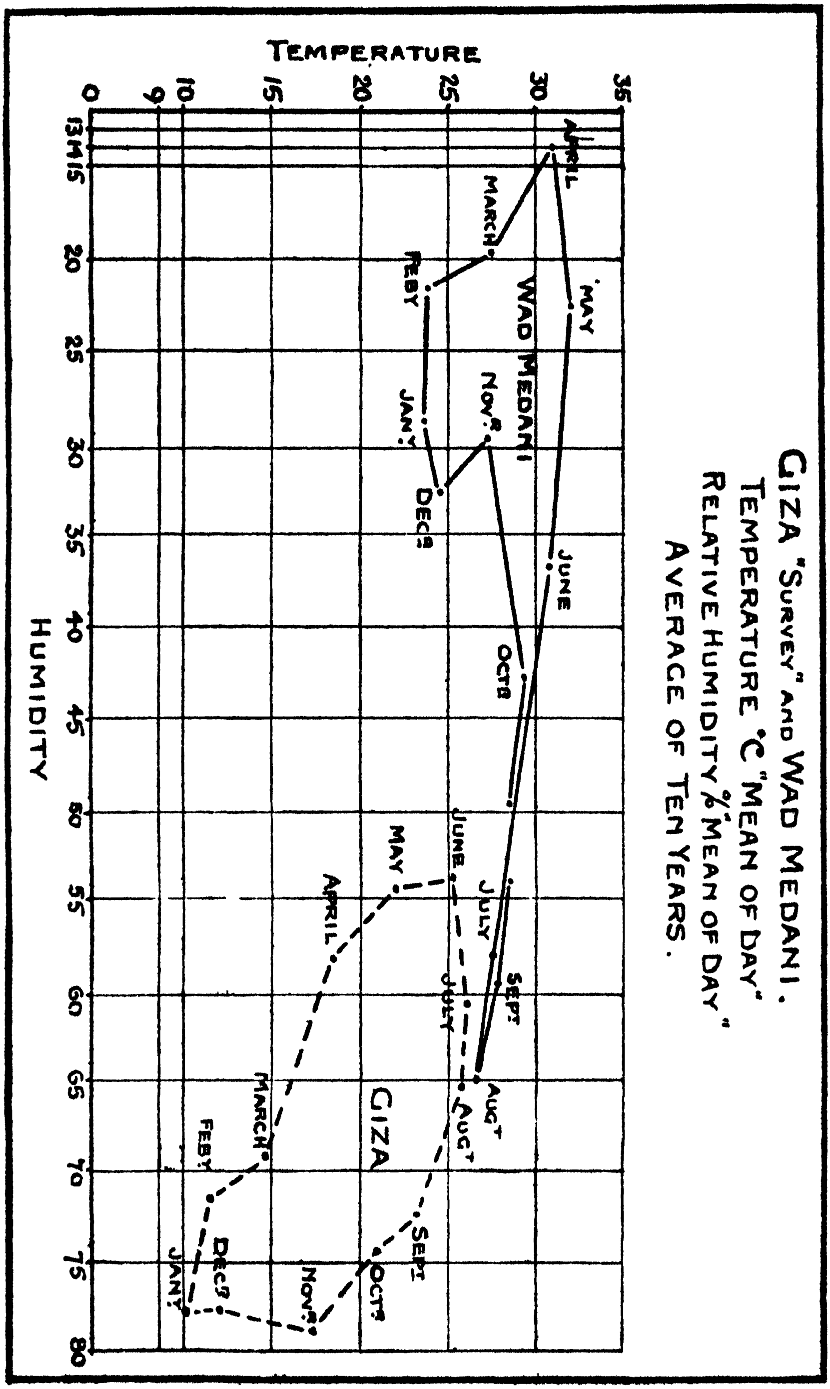


FIG. 6.

Months of the year at Wad-Medani and Giza represented as the correlation diagram as to their respective temperature and humidity.

The Nile starts to rise at Roda in July, and a little before this period the atmospheric humidity begins to increase. The temperature reaches its maximum for the year in July, after which it gradually falls until February when it rises again. From August until November there is a distinct rise in humidity and a decrease in temperature; after November humidity decreases, but the temperature continues to fall until January. It is during the period from August to November that the leaf spot is prevalent. By the end of November most of the cotton plants are pulled up. In the case of the cotton plants sown in September at Giza the disease was severe in December and January, after which the plants revived to a certain extent. The yield was, however, very poor.

From March, when most of the cotton is sown, up to July no angular leaf spot is observed in Egypt; it is only after that period that the spot makes its appearance.

There seems to be, as far as this country is concerned, a direct correlation between the increase of atmospheric humidity, the decrease of temperature, and the appearance and spread of the leaf spot.

It is not possible, for the present, for the writer to compare the climatic conditions prevalent in the cotton-growing districts in the Anglo-Egyptian Sudan at the time of the appearance and the spread of Blackarm (September to November) with those of Egypt during the same months.

In the Anglo-Egyptian Sudan the disease attacks the plant during its early development, while in Egypt favourable climatic conditions for the attack happen to occur when the plant is fully mature.

Climatic conditions in both countries at the time the disease makes its appearance are similar. Figure 6 shows the months of the year represented as the correlation diagram for the humidity and temperature (average of 10 years) for each month of the year at Giza and Wad Medani respectively. From this diagram it is possible to see that the months of August, September, and October, as represented in the correlation diagram, for both countries, fall together in a correlation group. It is during these months that the disease is observed in both countries. This suggests that there are similar climatic conditions in both countries at the time the disease is prevalent.

SUMMARY.

The value of this paper is very relative. It shows that a leaf spot, with which is associated a bacterium similar to that described by Erwin Smith as causing the angular leaf spot in the United States, is widespread in Egypt on adult plants from August until the plants are pulled up in about the month of November.

The disease is generally of no economic importance in this country because climatic conditions favourable for its spread are absent during the greater and more important period of the life of the cotton plant. If, however, cotton is sown from August to September, the conditions prevailing then favour the spread of the disease, but happily for this country such is not the case. The temperature rises and the humidity gradually decreases with the development of the cotton plant, from March to June. By August the plant is practically fully developed and is naturally less liable to suffer from an injury such as that caused by the angular leaf spot, than is the case with plants which happen to be, at the time, still young.

The change in climatic conditions in Egypt due to the rise of the Nile seems to be the reason for the spread of this disease. By the time the cotton is sown, climatic conditions become unfavourable to it.

In both countries, Egypt and the Anglo-Egyptian Sudan, there seems to be a correlation between weather conditions and the spread of the disease.

Received September, 1929.

A MIXED CONSIGNMENT

BY

W. GILHESPY.

AMIR ALI, of the Kashkeli tribe, owner of 8,000 acres of rich land, patriarch and virtual ruler of Kareempur, had been gathered to his fathers, and his only son inherited his wealth, power, and responsibilities. The grey-beards shook their old heads and prophesied disaster; had not Hafiz Khan absorbed new ideas in the great city schools ?

They abhorred new ideas, and their worst fears were realized: the young ruler was a reformer. There are no primrose paths for the sincere reformer in India, and Hafiz Khan had to face subtle opposition from the very men he sought to benefit. During the dry season he set his men to repair the bunds which kept back the overflow from the river when icy trickles from melting Himalayan snows gathered forces and formed foaming torrents to fertilize the parched fields of Ind. They believed in waiting to see if repairs were really necessary; if the river's overflow flooded the crops was it not ordained of kismet, and who can escape his fate ?

The young men grumbled bitterly, behind the ruler's back, when he bade them cut down scrub jungle and build corduroy roads in place of tracks where the bullock carts had sunk felloe deep in sand. But worse was to come. Instead of allowing them to laze under the trees during the slack season, the zemindar ordered them to cart manure to the fields. Why should land be manured ? Was it not less trouble to throw the accumulated filth into the nearest watercourse when it bred a plague of flies and the stench rose to heaven ?

Surely there was to be no end to this young man's folly, they mourned, when he actually *bought* ploughs; they had always made their own from poles cut in the jungle, and had given the village *loohar* a measure of corn for affixing an iron point to the lower beam—light ploughs which a man could carry on his shoulder or a pair of tiny bullocks could pull easily. The zemindar made them use strong, broad-pointed ploughs. which turned over the soil instead of merely scratching it.

His word was law; they lived under the patriarchal system. They lived in his houses, carried their disputes to him for settlement,

and obeyed his ruling; they were entirely dependent on him. They worked on the *batthai* system, cultivating that portion of land which he allotted to them; for an agreed percentage of the crop they provided bullocks, and did all manual labour while the zemindar paid water rates and taxes, also providing water wheels—and now, much to their disgust, those new ploughs.

The old men prophesied disaster when Hafiz Khan bought cotton seed instead of saving it from his own crop as his forefathers had done. It came, they had been told, from Madras, having been grown by idolaters who spake strange tongues instead of the pure Urdu which sensible people understood. It came from Afrique beyond the seas, where woolly-headed, ebony-coloured giants obeyed evil men called witch doctors instead of consulting respectable mullahs. Surely disaster would follow such folly.

Success followed instead. The new cotton yielded enormously—big bolls of long-stapled cotton, which filled the women's baskets as fast as the men could cart the stuff to the sheds; clean, fine cotton' such as even Dhurrum Singh admitted he had never bought before. He was a just man, old Dhurrum Singh, and, being a bunnia, he knew how to do business. He sent a sample to Bombay, was offered a good price, and passed it on to the zemindar.

The ryots grumbled no longer; they were earning two rupees where they had got one before. They still revered ancient custom and worshipped hoary tradition, but they loved easy money better, and were eager to grow more and more cotton, less tobacco and cereals. They worked with greater zest, fed their bullocks better, and drove the plough more deeply into the furrow.

For two golden years they prospered; then the ancients who had prophesied disaster shook their old heads in senile satisfaction when trouble overtook the zemindar. Real trouble: Dhurrum Singh died, and one Harput Rai bought the cotton mill.

The old man had dealt fairly; his successor was resolute to make the most of his monopoly. He declared his intention of buying cotton at a flat rate, and a low one at that, paying no more for the very best than for stuff grown from inferior seed, often on exhausted land. Hafiz Khan could have got 60 per cent. more by taking his produce to Meeraganj, but that involved a road journey of 34 miles and the cost was prohibitive. The zemindar offered to buy the mill, but the bunnia refused to sell; then he offered to pay a fair charge for ginning and baling; there was subtle insolence in the smile with which Harput Rai accompanied his second refusal.

The zemindar realized that that meant the end of cotton growing

for him; yet he would not accept the bunnia's outrageous terms for the cotton he had on hand. He paid his ryots in full for their share, and stored all he had. He grew bitter in his disappointment. All his thoughts were for his land and his dependents; he cared more for that which he grew than for the price it brought him, more for the ryots who tilled his fields and their well-being than for the added wealth they helped him to garner. Except when religious fanaticism stirs them, Moslems and Hindus live and work amicably side by side; but it takes little to kindle the spark of racial hatred when vital interests are at stake.

Harput Rai knew of the zemindar's bitterness, and gloated. He was of very lowly origin; a few lucky deals had raised him from poverty to wealth and power, and he lost his head. Hafiz Khan had position and power such as the bunnia could never attain, and the knowledge galled the upstart. His insane jealousy prompted him to offer the zemindar's cultivators extra wages to work in his mills, and they treated his offer with contempt. Then, with honeyed words which did not conceal his venom, he flouted the zemindar over his failure.

"Think," he concluded, while the other sat in contemptuous silence. "Thy ryots must live, fair words will not fill their children's bellies nor feed their oxen. Let them grow more cotton and, out of the pity which my heart feeleth for them, I will buy all they can grow."

"Pity!" the zemindar repeated, and his low level tones warned the bunnia that he had aroused a man who was slow to anger. "Pity? Since when did the snake know pity for the bird it doth swallow? Pity for *my* people? *Thou?* Pity thyself, thou whose belly is filled with lies—pity thyself now."

The bunnia did. He had cause. His friends and relatives who witnessed his punishment dared not even protest, being of the same timid race. Under the trouncing which Hafiz Khan administered the wretch yelled for mercy, wept loudly, and promised amendment. He lay in feigned unconsciousness as Hafiz Khan slipped his foot into the shoe with which he had beaten his insolent enemy, moaned feebly as the avenger marched away, then let loose a torrent of futile invective when the zemindar was out of hearing.

"I will spend my last rupee in making that eater of cow's flesh kiss the dust," he frothed. "I will bring him cringing to my feet. I will——"

"Let wisdom guide thy tongue—or keep it silent," a disgusted elder interrupted. "That Moslem cometh of a proud race, and such as he grovel not at any man's feet. Moreover, he is hereditary

ruler of a strong tribe; are the Kaskelis weaklings? How many be there among his ryots who would gladly cut thy throat out of loyalty to their chief—aye without awaiting his order? How long will it be ere one Harput Rai is carried to the burning ghat if his young men should learn of this flouting?"

Others gave good advice, but the bunnia was in no mood to listen. A beating with a shoe is, to the Oriental, and especially to the Hindu, the acme of degradation. But for what purpose had British courts of justice been established if not that such as he might gloat over the discomfiture of better men? Hafiz Khan did not deign to plead provocation when summoned to court; he paid the small fine imposed, but the next train took him far from his home. The bunnia's subtle judgment had not erred, Hafiz Khan had suffered more acutely than he had; proudly he boasted that he had driven his enemy away.

His triumph was short-lived: Hafiz Khan had run away from a burning desire to have the bunnia slain as his forefathers would have done in ruder days, if, indeed, any bunnia could have mustered the courage to defy *them*. In his voluntary exile he had time for calm reflection; he admitted that his outburst had been as futile as it was unbecoming to his position, and if only for the sake of his dependents he must return and do his duty.

He settled down to work with renewed energy; without a profitable market for his cotton it was folly to grow it, but he could not wrest his mind from the project nor lie down under defeat. All unconsciously he tried to formulate a plan which would give him the desire of his heart; all unconsciously he watched the man who had thwarted him. How had Harput Rai obtained the money which had bought the mill? Previous to the venture he had been only a petty trader, yet even now his wealth was increasing and his operations were being extended rapidly.

A rumour reached Hafiz Khan and he set out to follow the bunnia's movements much more closely. Harput Rai made mysterious journeys to Bombay with quite small consignments of cotton; these journeys usually followed still more mysterious ones to the adjoining native state, where bribery was rife and the breaches of certain laws were often winked at. Twice the bunnia went there as a petty hawker; once in the surest and safest of all disguises, that of a religious mendicant. With the utmost caution Hafiz Khan, also disguised, followed him. On the third trip he learnt the secret of the other's wealth, knew why he made so many trips to Bombay.

When Harput Rai again sent a small parcel of cotton to the

port, carefully superintending the loading of the bales himself, the zemindar went ahead and waited. His hair and beard were dyed with henna to give him the appearance of age, and he wore rough, soil-stained cotton clothes, passing unnoticed among the vociferous crowd at the Bombay goods terminus.

Dusty and travel-stained, weary of the ceaseless city din, but with the abiding patience of the Oriental, he kept his vigil till Harput Rai came with a Cutchi bullock-cart to take delivery of the cotton. From behind an empty truck the zemindar watched the other man single out one particular bale and help to roll it aside. When it was securely tied and the bunnia had taken his seat on it the cart moved off. Hafiz Khan followed it through the crowded streets, now patrolled by watchful mounted police or small parties of soldiers to suppress conflicts between Moslems and Hindus.

" Kill! Kill! Strike and spare not! Strike for the faith—strike and spare not! Slay the accursed who have defiled the House of Prayer!"

A fleeing band of Hindus, followed by Moslem pursuers, rushed out of a side-street. Shopkeepers were hastily putting up their shutters, a couple of policeman pushed their way into the crowd and were trampled underfoot.

"*Devi ka Jai!*" "*Ram! Ram!*" "*Rasool ka nam!*" Different sects called on different gods, yet fought like demons. Hindus gathered and soon outnumbered the Moslems, who gave ground till a small but resolute band of Pathans appeared from nowhere. In grim silence those fierce warriors of Afghanistan or the border hills fought their way to the thickest of the fray.

Bullock-carts were left untended as their drivers fled for their lives; Harput Rai dropped to the ground, but, before he could find a hiding-place, he was felled by a blow from a heavy bamboo pole. Before Hafiz Khan could drag him to safety a pair of bullocks dragged an empty cart over him, and the mob swept the zemindar off his feet. He rose when they went on, hauled the unconscious man to the pavement, and stood guard over him.

" His life is of little use to anyone," he mused. " Ind and hell are full of such, but I have need for him." He wiped the blood which trickled from a cut on his cheek, and wished that the turmoil would cease; he had work to do.

Silence, chilling in its sudden fall, announced the arrival of mounted police. Led by British officers they galloped forward from either end of the wide bazaar and the crowd broke, leaving a few dead and many wounded. The foot police followed with the ambulances, and

Hafiz Khan secured one by the simple method of dragging it towards where his enemy lay.

"Doth he live, this bunnia?" he asked one of the policemen.

"The gods alone know," the man said testily; then, with quick suspicion, "Who art thou? One of the killers? Speak—swiftly."

Hafiz Khan spoke—slowly. The policeman hurried away; he preferred smelling out firebrands who fanned the flame of racial hatred to interviewing rustics. Hafiz Khan saw the bunnia borne away in the ambulance, mounted the bullock-cart, and drove it away.

It was a fortnight before he was allowed to see the injured man.

"I have brought thee peaches and grapes that thy thirst may be quenched, these being such as a Mahomedan may offer to a Hindu," was his greeting. "May Allah send thee complete recovery speedily." He took his leave after a short stay, leaving the patient to agonizing doubts. What did his enemy know? How much was mere suspicion? Had he been in communication with the police?

"I took great care of thy cotton," he told Harput Rai on his next visit.

"Where—where is it?" the other asked and tried not to show his fear.

"It is safe, the police cannot find it—unless I help them." The zemindar's tones were gentle, those of the other were hoarse with dread as he tried to bluster.

"The police? What have they to do with my cotton?"

"Nothing, but they search diligently for opium and cocaine."

"Cocaine? There was no cocaine amidst the cotton," the bunnia hissed; then realized that he had given himself away.

"No? Only opium?" Hafiz Khan drawled. "Well, thou knowest best." The sick man watched him in apprehensive silence till the time came for visitors to leave.

"Stay—one little moment, stay," he pleaded. "What wilt thou do now? I am in thy hands. Surely thou wilt be merciful to one who is ill and helpless?"

Though he pleaded for mercy, he expected none; the zemindar's terms were lenient, for he was too proud to take advantage of a helpless foe. The incriminating bale would be restored to the bunnia, provided he entered into a bond to sell the cotton mill at the price already offered.

"I will leave thee to consider the matter," Hafiz Khan said quietly, as he left the stricken man to his thoughts. They were such as to drive away sleep; he had to view the zemindar from a new angle. Always he had regarded him as a blundering,

honest fool, without a thought beyond his crops; this unexpected proof of intelligence, this quiet tenacity of purpose, filled the schemer with a lively dread. As easily as a cultivator turns his plough into the furrow, the despised landowner had turned the tables on the man who had once thwarted him.

Cocaine? He had run great risks and won great profits in the illicit opium traffic, but he had never handled cocaine. Yet he was firmly convinced that Hafiz Khan had slipped cocaine into that bale which contained opium, carefully hidden among cotton and carted openly through the busiest streets in the second city of the Empire! He had chuckled over his smartness, and this clumsy cultivator had been infinitely smarter. Oh yes, he was quite sure about the cocaine; it was just the kind of trick he would have played on a foe, and he could only judge others by his own standard. He had thwarted and shamed a man in a position far above his own; why should that man not mete out punishment a hundredfold when he could? The zemindar's simple honesty and contemptuous leniency were utterly beyond the quivering wretch's comprehension, and his suspicion—his certainty—that a trap was laid for him enhanced the grey pallor which sickness had brought to his cheeks.

"I have brought the bond for thee to sign," Hafiz Khan told him on his next visit. "Read it carefully. When the mill is mine the purchase price shall be thine."

"The bale—the police cannot find it?" the sick man asked. "Thou hast not spoken to them of——"

"I keep my promises—I am not of *thy* breed," was the coldly contemptuous answer. "Now sign—or suffer."

Not even Hafiz Khan's ryots, now in the unique position of being able to sell their cotton at full market price, know why Harput Rai sold his mill to their ruler and came no more to Kareempoor. Hafiz Khan is too proud to boast.

COTTON STATISTICS
CONSUMPTION AND STOCKS

BY

JOHN A. TODD, M.A., B.L.

LAST year the feature of the Consumption statistics was that both American and Egyptian showed consumption largely in excess of the crop. That is again true to a modified extent of American this season, but not of Egyptian, where, owing to a much larger crop, a considerable addition has been made to the Carryover.

As regards American the total is over 15,000,000 bales for the third season in succession, but this year the round figure is just exceeded and no more. The first half of the season showed a substantial increase on the very low figure to which the second half of the previous season fell, but the improvement was hardly maintained in the second half. The total of 15,076,000 running bales (excluding linters) compares with the 1928 crop figure of 14,297,000 running bales.

Looking backwards it is interesting to note that the second half of the season 1926-27 reached a total of 8,356,000 bales, while the first half of season 1927-28 was 8,228,000, making a total for the period of twelve months of 16,584,000 bales. That represented the record world's consumption, and was due to the very low price of American as the result of the record crop of 1926.

One question which has perturbed the cotton world during the past season is why the price has persistently refused to rise at least as high as in the previous season, as it apparently should have done according to the supply statistics shown in the following table:

WORLD'S SUPPLY, PRICE AND CONSUMPTION OF *AMERICAN* COTTON.

(RUNNING BALES 000's—LINTERS EXCLUDED.)

Season.	SUPPLY.			CONSUMPTION.			*Season's Average Price.*
	Carryover, July 31.	*Crop.*	*Total.*	1*st Half.*	2*nd Half.*	*Total.*	*Pence per Lb.*
1926–27	5,358	17,755	23,113	7,421	8,356	15,777	8·15
1927–28	7,484	12,783	20,267	8,228	7,179	15,407	11·17
1928–29	4,952	14,297	19,249	7,613	7,463	15,076	10·52
1929–30	4,333	*14,919*	*19,252*	—	—	—	—

The answers usually given in the trade are (1) that during the past season the world shifted over to a substantial extent from American to Indian cotton; and (2) the increasing use of outside growths of all kinds in place of American. The Federation statistics, however, do not bear out these arguments. It will be seen that while the world's consumption of Indian cotton in 1928-29 was well above that of 1927-28, it was still below that of the previous four seasons; in other words, the consumption of Indian cotton during the past season has merely returned to something like normal. As to the consumption of Outside Growths, Egyptian shows no change to speak of, while the total consumption of Sundries has barely maintained the high level of 1927-28. It must, of course, be remembered that the statistics of Sundries are very much confused by the figures in those countries where the bale weight is small. Thus Russia's consumption of Sundries (chiefly her own cotton, which is in bales of small weight) has now gone back to pre-war figures, which means that it is well above anything in recent years; whereas her consumption of American has fallen sharply during the second half of last season. This is in line with the rapid recovery of the Russian crop, which in 1928 was back to about the same figure as 1914.

The relative position of the U.K. in the World's Consumption shows no improvement at all; in fact, our consumption of American for the season is the lowest since 1923-24. The figures of Egyptian showed very little improvement to set off against this, though there is a fair increase in the use of Indian; but the most disconcerting feature is the heavy drop in the consumption of Sundries, which incidentally includes all Empire cotton except Indian; and the result is that our total consumption of all kinds of cotton is again the lowest since 1923. These two points are strikingly brought out in the diagram attached, which, by the way, also shows very clearly the drop in the Continental consumption of American during the past season for the first time since 1923-24.

The World's Carryover of American Cotton (Table III.) shows a further fall for the season and makes the total the lowest since July, 1925. It will not stand much further depletion. The Egyptian, on the other hand (Table IV.), shows an increase of fully a million kantars, but is still below the record of July, 1927.

TABLE I.—WORLD'S CONSUMPTION OF COTTON.

(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)

(Running Bales, 000's Omitted—Excluding Linters.)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*All Others.*	*Totals.*
American ..	1911-13*	3,701	4,865	5,086	513	132	14,297
	1923-24	1,695	3,199	5,353	661	172	11,080
	1924-25	2,344	4,009	5,917	772	228	13,270
	1925-26	2,093	4,194	6,176	1,012	261	13,736
	1926-27	2,077	4,797	6,880	1,756	267	15,777
	1927-28	1,949	5,143	6,535	1,513	267	15,407
	1928-29	1,910	4,614	6,788	1,431	333	15,076
	1st Half	971	2,509	3,305	670	158	7,613
	2nd ,,	939	2,105	3,483	761	175	7,463
Indian ..	1911-13*	49	807	5	3,043	1	3,905
	1923-24	201	1,247	27	3,922	7	5,404
	1924-25	183	1,108	31	4,165	34	5,521
	1925-26	168	1,063	30	4,273	38	5,572
	1926-27	82	855	28	4,203	28	5,196
	1927-28	121	962	27	3,389	24	4,523
	1928-29	183	1,150	35	3,766	44	5,178
	1st Half	9[illegible]	565	10	1,877	30	2,574
	2nd ,,	91	585	25	1,889	14	2,604
Egyptian ..	1911-13*	384	377	127	20	7	915
	1923-24	469	354	149	39	16	1,027
	1924-25	431	350	128	49	13	971
	1925-26	391	334	136	42	17	920
	1926-27	369	389	160	51	25	994
	1927-28	358	394	145	43	17	957
	1928-29	365	401	155	43	25	989
	1st Half	191	201	75	20	10	497
	2nd ,,	174	200	80	23	15	492
Sundries ..	1911-13*	140	1,946	26	774	939	3,825
	1923-24	353	529	76	1,351	576	2,885
	1924-25	277	896	66	1,523	785	3,547
	1925-26	370	1,619	58	1,308	1,103	4,458
	1926-27	482	1,511	64	1,362	753	4,172
	1927-28	476	1,557	64	1,646	911	4,654
	1928-29	342	1,947	55	1,480	815	4,639
	1st Half	186	828	28	697	445	2,184
	2nd ,,	156	1,119	27	783	370	2,455
All kinds ..	1911-13*	4,274	7,995	5,244	4,350	1,079	22,942
	1923-24	2,718	5,329	5,605	5,973	771	20,396
	1924-25	3,235	6,363	6,142	6,509	1,060	23,309
	1925-26	3,022	7,210	6,400	6,635	1,419	24,686
	1926-27	3,010	7,552	7,132	7,372	1,073	26,139
	1927-28	2,904	8,056	6,771	6,591	1,219	25,541
	1928-29	2,800	8,112	7,033	6,720	1,217	25,882
	1st Half	1,440	4,103	3,418	3,264	643	12,868
	2nd ,,	1,360	4,009	3,615	3,456	574	13,014

* Average of 1911-12 and 1912-13.

TABLE II.—U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

		Total.	*Upland.*	*Sea Island.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
Season's Totals.	1912–13	5,483·4	5,195·6	54·8	—	201·3	31·7	303·0
	1913–14	5,577·4	5,301·4	81·7	—	151·1	43·2	307·3
	1914–15	5,597·4	5,295·9	79·4	—	181·2	40·8	411·8
	1915–16	6,397·6	5,998·0	82·6	—	269·3	47·7	880·9
	1916–17	6,788·6	6,376·0	94·3	--	259·2	59·1	869·7
	1917–18	6,566·5	6,296·8	85·9	—	136·4	47·4	1,118·8
	1918–19	5,766·0	5,517·6	51·2	21·1	126·1	50·0	457·9
	1919–20	6,419·8	5,914·2	43·0	45·9	323·1	93·6	342·5
	1920–21	4,892·7	4,641·5	18·7	16·8	159·2	56·6	516·3
	1921–22	5,909·9	5,554·7	9·0	49·4	226·3	70·5	639·0
	1922–23	6,666·1	6,250·8	6·3	65·2	262·3	81·5	646·1
	1923–24	5,680·6	5,312·0	4·9	36·0	223·6	104·0	536·7
	1924–25	6,193·4	5,894·5	4·0	19·0	191·5	84·4	658·8
	1925–26	6,455·9	6,161·7	2·3	11·7	204·1	76·0	803·8
	1926–27	7,189·6	6,859·2	1·2	19·7	239·8	69·7	806·1
	1927–28	6,834·1	6,518·6	1·3	15·1	217·6	81·5	780·2
	1928–29*	7,099·0	6,771·8	—	16·2	231·0	80·0	870·9
*Monthly Figures, 1927–28.**	August	634·5	604·0		1·1	22·5	7·0	76·2
	September	627·8	599·7		1·1	19·8	7·1	80·4
	October	613·5	586·0	-	1·2	19·4	6·9	75·3
	November	626·7	598·7	—	1·3	20·5	6·2	63·9
	December	538·8	512·7		1·3	18·9	5·9	53·8
	January	586·1	557·8	—	1·5	20·2	6·6	56·1
	February	572·9	544·1		1·4	20·4	6·9	57·8
	March	581·3	555·9		1·4	17·1	7·0	63·1
	April ..	524·8	500·7		1·1	16·5	6·5	59·9
	May ..	577·4	553·4		1·2	14·9	7·8	62·8
	June ..	510·4	488·2	--	1·2	14·0	7·1	65·6
	July ..	439·8	418·4	--	1·3	13·4	6·7	65·3
*Monthly Figures, 1928–29.**	August	526·3	500·8	—	0·8	18·8	6·0	70·1
	September	492·3	469·7	--	0·4	16·3	5·8	70·9
	October	616·2	588·6	—	0·9	20·1	6·7	78·8
	November	610·9	586·9	—	1·3	17·6	5·1	68·6
	December	534·4	510·6	—	1·3	17·8	4·6	59·6
	January	668·4	638·1	—	1·8	22·2	6·3	68·6
	February	598·1	570·9	—	1·3	19·5	6·4	68·1
	March	632·8	603·8	—	1·4	20·5	7·1	76·7
	April ..	631·7	603·0	—	1·2	20·1	7·4	79·0
	May ..	668·2	637·2	—	1·3	20·5	9·2	80·1
	June ..	570·3	543·3	—	1·5	18·1	7·4	78·2
	July ..	546·5	516·5	—	1·8	20·3	7·9	79·3
1929–30.*	August	558·1	528·4	—	1·4	20·3	8·0	83·6
	September	545·6	518·0	—	0·9	17·5	9·2	82·0
	October	640·8	609·0	—	1·5	20·2	10·0	82·7

* Subject to revision.

TABLE III.—WORLD'S MONTHLY CARRYOVER OF *AMERICAN* COTTON.

(IN THOUSANDS OF RUNNING BALES, INCLUDING LINTERS IN U.S.A., ALSO SEA ISLAND AND AMERICAN EGYPTIAN, BUT NOT FOREIGN COTTON.)

End of	*Stock and Afloat.*		*U.S.A.*		*Monthly Totals.*	*Federation.*	*Half-Yearly Totals.*	*U.S.A.*	*End of Season Totals.*
	U.K.	*Continent.*	*Mill Stocks.*	*Public Warehouses.*		*Other Mill Stocks.*		*Elsewhere.*	
1912, August ..	508	406	786	556	2,256	1,305	3,561	350	3,911
1913, August ..	423	282	699	492	1,896	1,011	2,907	375	3,282
1914, August ..	627	489	687	562	2,365	—	—	320	—
1915, July ..	1,238	753	1,491	1,839	5,321	—	—	850	—
1916, July ..	707	516	1,591	1,150	3,964	—	—	450	—
1917, July ..	237	332	1,521	1,069	3,159	—	—	440	—
1918, July ..	173	164	1,541	1,924	3,802	—	—	315	—
1919, July ..	806	486	1,519	2,402	5,213	—	—	1,150	—
1920, July ..	878	474	1,485	2,262	5,099	1,066	6,165	500	6,665
1921, July ..	839	805	1,222	3,874	6,740	1,137	7,877	1,960	9,837
1922, July ..	558	562	1,266	1,468	3,854	1,243	5,097	185	5,282
1923, July ..	187	206	1,109	903	2,405	713	3,118	310	3,428
1924, July ..	228	310	739	695	1,972	688	2,660	220	2,880
1925, July ..	401	373	916	516	2,206	1,046	3,252	270	3,522
1926, July ..	579	406	1,155	1,946	4,086	959	5,045	595	5,640
1927, July ..	1,011	1,079	1,524	1,856	5,470	1,731	7,201	590	7,791
August ..	906	816	1,215	2,197	5,134	—	—	—	—
September	805	960	1,189	3,979	6,933	—	—	—	—
October ..	782	1,174	1,401	5,441	8,797	—	—	—	—
November	764	1,408	1,653	6,005	9,830	—	—	—	—
December	728	1,411	1,839	5,685	9,663	—	—	—	—
1928, January ..	721	1,354	1,853	5,043	8,971	1,243	10,214	—	—
February	731	1,295	1,817	4,347	8,190	—	—	—	—
March ..	717	1,230	1,740	3,541	7,228	—	—	—	—
April ..	751	1,164	1,651	2,943	6,509	—	—	—	—
May ..	706	1,083	1,462	2,283	5,534	—	—	—	—
June ..	612	978	1,265	1,669	4,524	—	—	—	—
July ..	530	815	1,094	1,201	3,640	1,181	4,821	385	5,206
August .	441	646	838	1,151	3,076	—	—	—	—
September	373	746	757	2,651	4,527	—	—	—	—
October ..	449	965	1,240	4,650	7,304	—	—	—	—
November	679	1,287	1,636	5,279	8,881	—	—	—	—
December	850	1,422	1,855	5,341	9,468	—	—	—	—
1929, January ..	938	1,338	1,901	4,656	8,833	1,260	10,093	—	—
February	930	1,243	1,891	3,921	7,985	—	—	—	—
March ..	864	1,115	1,879	3,216	7,074	—	—	—	—
April ..	830	1,001	1,747	2,551	6,129	—	—	—	—
May ..	694	810	1,595	1,867	4,966	—	—	—	—
June ..	543	679	1,373	1,394	3,989	—	—	—	—
July ..	442	563	1,119	982	3,106	1,197	4,303	325	4,628
August ..	367	418	836	1,375	2,996	—	—	—	—
September	339	584	811	3,223	4,957	—	—	—	—
October ..	454	1,000	1,401	5,323	8,178	—	—	—	—

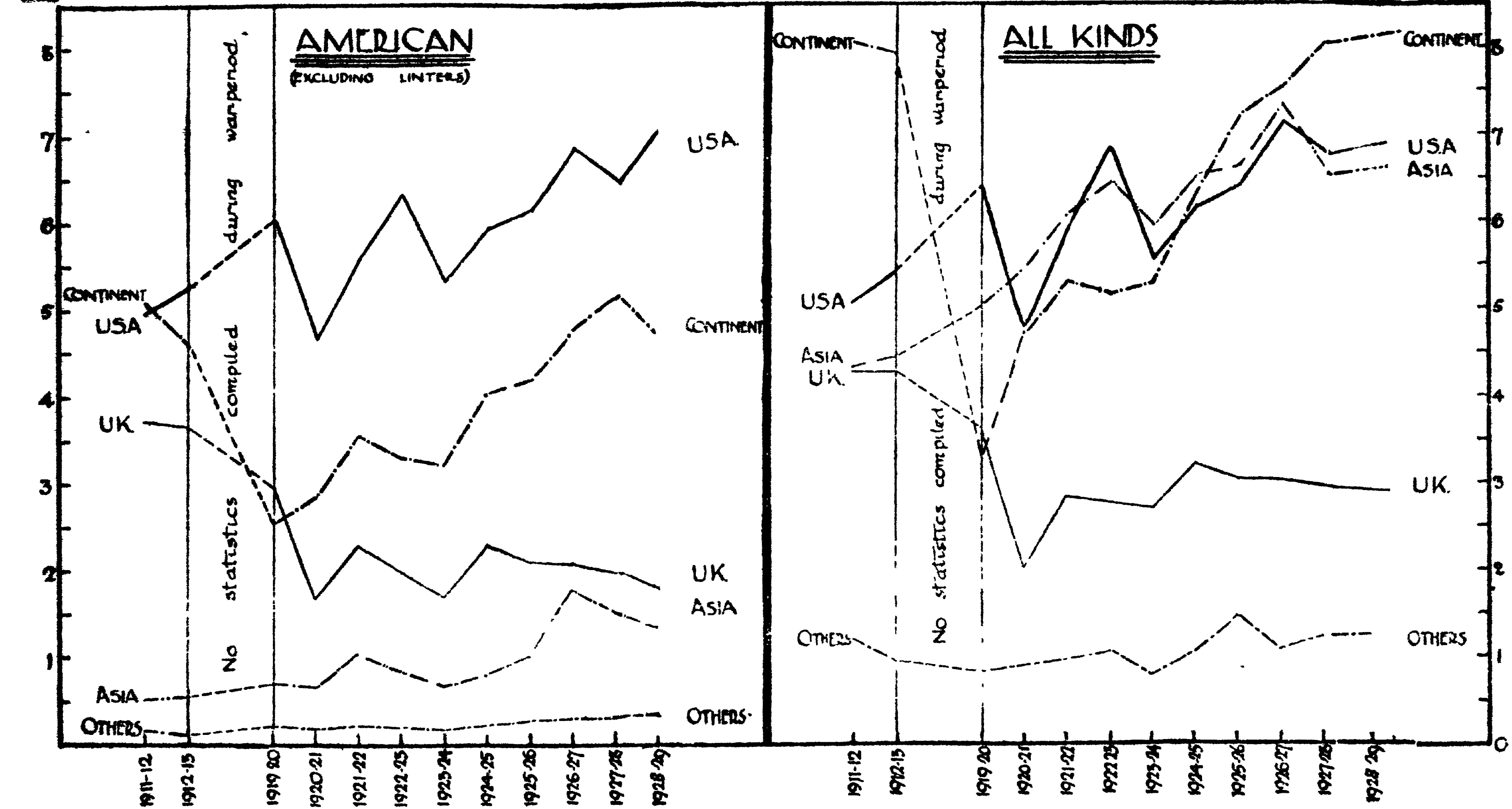
TABLE IV.—WORLD'S CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000'S BALES CONVERTED AT 7·5 KANTARS (EUROPE) AND 5·0 KANTARS (U.S.A.).)

End of	*Stock and Afloat.*		*U.S.A.*		*Alexandria.*	*Monthly Totals.*	*Federation.*	*Half-Yearly Totals.*
	U.K.	*Continent.*	*Mills.*	*Warehouses.*			*Half-Yearly.*	
1912, August ..	302	30	424*	—	350	1,106	1,387	2,493
1913, August ..	418	31	354	13	491	1,307	1,485	2,792
1914, August ..	467	10	259	26	766	1,528	—	—
1915, July ..	758	71	484	126	1,074	2,513	—	—
1916, July ..	351	50	617	296	104	1,418	—	—
1917, July ..	431	27	376	213	589	1,636	—	—
1918, July ..	541	185	180	157	1,727	2,790	—	—
1919, July ..	526	170	185	79	2,060	3,020	—	—
1920, July ..	466	79	587	514	601	2,247	1,365	3,612
1921, July ..	688	158	345	296	1,992	3,479	1,005	4,484
1922, July ..	835	148	314	267	1,669	3,233	1,252	4,485
1923, July ..	859	129	447	265	1,096	2,796	1,200	3,996
1924, July ..	517	128	259	63	384	1,351	1,155	2,506
1925, July ..	443	75	253	57	411	1,239	1,103	2,342
1926, July ..	930	120	321	143	1,544	3,058	1,185	4,243
1927, July ..	1,260	143	295	66	2,392	4,156	1,283	5,439
August ..	1,088	127	277	67	1,816	3,375	—	—
September	908	112	262	88	2,240	3,610	—	—
October ..	780	165	230	85	2,842	4,102	—	—
November	735	210	256	73	3,208	4,482	—	—
December	758	187	275	94	3,228	4,542	—	—
1928, January ..	690	203	295	92	3.197	4,477	1,080	5,557
February	713	135	270	95	3,021	4,234	—	—
March ..	878	120	242	124	2,916	4,280	—	—
April ..	930	165	236	132	2,727	4,190	—	—
May ..	1,035	105	245	122	2,520	4,027	—	—
June ..	998	127	241	98	2,108	3,572	—	—
July ..	923	98	239	88	1,648	2,996	1,035	4,031
August ..	818	105	237	69	1,153	2,382	—	—
September	750	68	234	66	1,427	2,545	—	—
October ..	750	180	196	66	2,340	3,532	—	—
November	960	195	175	74	3,227	4,631	—	—
December	923	232	181	124	3,555	5,015	—	—
1929, January ..	802	225	223	131	3,458	4,839	1,140	5,979
February	1,043	150	228	130	3,326	4,877	—	—
March ..	1,185	150	243	132	3,116	4,826	—	—
April ..	1,395	173	314	189	2,931	5,002	—	—
May ..	1,560	158	408	226	2,618	4,970	—	—
June ..	1,447	158	446	215	2,135	4,401	—	—
July ..	1,358	150	449	197	1,677	3,831	1,260	5,091
August ..	1,268	165	458	174	1,164	3,229	—	—
September	1,148	120	454	161	1,332	3,215	—	—
October ..	1,125	180	397	142	2,536	4,380	—	—

* Total foreign—details not given.

WORLD'S CONSUMPTION OF COTTON (from the INTERNATIONAL FEDERATION Statistics)



NOTES ON CURRENT LITERATURE

[The commencement of a new volume has given opportunity for a further subdivision of these notes. New headings are: (*a*) Soils and Manures; (*b*) Fibre, Yarn, Spinning, Weaving, etc.; (*c*) Trade, Co-operation.]

COTTON IN INDIA.

1. The Application of Science to Crop-Production. An experiment carried out at the Institute of Plant Industry, Indore. By A. and G. L. C. Howard. (Humphrey Milford, Oxford University Press, B.I. Building, Nicol Road, Bombay. 1929. Price 9s.) In Chapter I. is described the origin of the Indore Institute as a natural sequel to that at Pusa, together with the history of the gradual carrying out of the idea of having a central institution for the study of actual crop-production, with less fragmentation of the factors therein concerned among the various ancillary sciences. The plant yielding the crop must be studied in relation to the soil, the conditions of village agriculture, the economic uses, etc. Chapter II. goes on to describe the Institute itself, and its layout; it covers 300 acres.

Chapter III. deals with investigations on cotton, which form the chief line of work, as the place owes its origin to the grants made by the Indian Central Cotton Committee. The programme falls into three groups: (1) The investigation of fundamental questions, the results of which apply to the whole of the cotton work in progress in India. (2) Genetics, including the improvement of the kinds of cotton now grown in Central India and Rajputana under dry and irrigated conditions. (3) Improvements in the agronomy of cotton.

A collection of unit species is in process of formation, and a careful study of their root-systems has already led to the explanation of facts hitherto not properly understood in the success or failure of cotton under various conditions. A preliminary survey of the root-systems of the Indian cottons has been made, with a view to discovering the general differences in type, and the effect of factors like soil-aeration or waterlogging upon root development. This work already seems to indicate the reasons for the success of roseum cottons and failure of Americans on black cotton soils. Variety improvement also is well under way.

Chapter IV. deals with improvements in the agronomy of cotton. It is con sidered that so far, as is necessarily the case in introducing improvement among a naturally conservative agricultural population, the line of least resistance—the introduction of obvious improvements like better varieties—has been taken, but that now other things may begin to receive attention, future work being a well-balanced combination of agronomy and genetics with soil science. An account is then given of the various factors limiting production upon black soil, and the measures that can be taken. Such factors are the growth of perennial grasses and soil erosion, in which matters the work done is of particular interest at the present time.

Chapter V. discusses further agricultural improvements, such as in well-irrigation, cattle, implements, machinery, etc.

Chapter VI. deals with liaison between the institute and its supporters.

In Chapter VII. the important subject of the organization of agricultural research is dealt with, this article forming a very important contribution to the subject (at present under consideration in our pages) from two workers who have themselves done brilliant work. The difficulties involved in the present system of "long range" and "local" research stations are pointed out, and a division

into "research" and "demonstration" stations is suggested as preferable. It is upon this conception that Indore is being organized. "Better men are needed, not more machinery" is the summing up; "the man is everything, the organization a minor matter." No one interested in agricultural progress should leave this book unread.

2. Mysore. *Cotton Breeding Experiments.* (*Admin. Rpt. of the Agr. Dept., Mysore,* 1927-28.) Breeding work was largely concentrated upon the hybrid *Gossypium arboreum-herbaceum.* Selection 69 seems certain to occupy most of the Sannahatti (Kumpta) area. Up to the present the growers of this selection have not reaped the full benefit from it, as it is being used quite extensively for mixing with the local cotton. An attempt will be made to organize cotton auctions so as to bring this variety to the attention of the larger buyers.

3. Cotton Investigation Work in the Punjab. (*Rpt. Dpt. Agr., Punjab,* 1927-28, Pt. II., Vol. 2, Lahore, 1929.) The following experiments are described: Varietal, cultural, and manurial experiments at the Hansi Station; varietal trials with American and Desi cotton, rotational, manurial, and spacing experiments at Lyallpur Agricultural Farm; varietal and manurial trials at Montgomery Farm; varietal experiments at Multan Agricultural Station; cultural and rotational experiments, and varietal trials with American and Desi cottons at Sargodha Agricultural Station.

4. Improved Working Conditions in Indian Mills. (*Text. Rec.,* xlvii., 559, 1929, p. 103.) The Factory Inspection Report published by Government gives statistics for the past year, and shows great progress in ventilation and sanitation in mills. In Ahmedabad, working conditions in several mills have been improved out of all recognition. Six new spinning and weaving mills will soon commence operations in this district and will be provided with cooling and ventilating arrangements. The number of accidents is growing less, and better care is taken in the fencing of machinery.

5. Quelques-uns des Problèmes de la Culture du Cotonnier Americain dans le Pendjab. By Trevor Trought. (*Coton et Cult. Coton.,* iv., 2, 1929, p. 115.) Beginning with the history of the introduction of American cotton to the Punjab, the author goes on to describe how Milne in 1907 began to select from the original Dharwar American, obtaining various forms that have been widely cultivated, such as 4 F. A description of the very trying climate is then given, with the general methods of cultivation employed, and the difficulties involved in dealing with the indigenous population.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

6. The following reports have recently been received:

Rothamsted Experimental Station Report for 1927-28.
Cyprus: Ann. Rpt. of Dpt. of Agr., 1928.
Gold Coast: Rpt. of Dpt. of Agr., 1928-29.
Nigeria: Rpt. of Dpt. of Agr., 1928.
Northern Rhodesia: Ann. Rpt. of Dpt. of Agr., 1928.
Sierra Leone: Ann. Rpt. of Lands and Forests Dpt., 1928.
Sudan: Rpt. of Finan. Admin. and Condition of the Sudan in 1928.
Uganda: Ann. Rpt. of Dpt. of Agr., 1928.
Meteorological Observations, 1928.

7. British Empire Producers' Organization. At a meeting of the Council and Vice-Presidents held at Imperial Chemical House on November 12 the following resolution, proposed by the Chairman, Lord Melchett, was unanimously carried: "That, having in mind the desirability of the adoption of a policy of

the development of the Empire as an economic unit, this Council recommends that immediate steps be taken to promote the conclusion of extended reciprocal trade agreements between the United Kingdom and the several parts of the Empire overseas."

8. EUROPE: Cyprus. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr., Cyprus.* 1928, p. 9.) The cultivation of cotton was hampered by lack of rain, which caused restriction of the area put down to dry cotton, and the scarcity of underground water also restricted the production of cotton planted under irrigation. In spite of the lesser area cultivated, however, the production was larger than that of the preceding year; this is attributed to the fact that the bollworm caused less damage.

It has been arranged to import, for the coming season, fresh seed from America and Egypt. A small quantity of Acala cotton, grown in the dry areas of California, will be given a trial.

9. ASIA: Ceylon. *Cotton Cultivation.* (*Admin. Rpt. of Actg. Dir. of Agr. for* 1928, p. D 11.) Although the area under cotton was increased by 400 acres in the Southern Division, the crop was little more than that of the previous season. This was caused by the unfavourable weather conditions, and by the depredations of two herds of elephants, which resulted in the abandonment of a considerable acreage in one of the best cotton-growing areas of East Giruwa pattu. The price paid for cotton was Rs. 17 per cwt. at Hambantota, Ambalantota and Bata-ata, and Rs. 16 per cwt. at Middeniya.

The cotton leaf-eating caterpillar was prominent in the early part of the season, and the leaf-rolling caterpillar in the later part. The bad weather conditions caused shedding of bolls and squares, but increased attention was paid to weeding and cultivation.

10. Further Experiments with Cotton in Malaya. By W. N. Sands. (*Malayan Agr. J.*, xvii., 2, 1929. Abstr. from *Coton et Cult. Coton*, iv., 2, 1929, p. 157.) Cotton cultivation is but little developed. The varieties studied include Assili, Sakellarides, Sea Island, Acala, and Cambodia. The chief pests are: *Sylepta derogata, Earias fabia, Dysdercus cingulatus.* Pink Bollworm has not yet been observed.

11. AFRICA: Gold Coast. *Cotton Cultivation.* (*Rpt. on the Dpt. of Agr.*, 1928-29.) "In the Northern Territories a dual programme was followed in connection with cotton development. Comprehensive trials were laid down at Tamale Investigational Station and a buying scheme was operated in the surrounding district. The yields obtained both on the Government farm and on native farms were low, as in previous years. The report of the Superintendent and the Economic Botanist, who carried out the investigational work, shows that there is very little doubt that the failure of the cotton is due to a combination of unsatisfactory distribution of rainfall and unsuitable mechanical composition of the soil, resulting in an abnormal amount of boll-shedding and severe incidence of pests and diseases. Investigations will be continued next year, and in particular the Agricultural Chemist will be stationed at Tamale to make a thorough study of the soil and soil conditions.

"The extension scheme was limited to the area surrounding Tamale and within economic reach of the ginnery. Cotton-seed was distributed free to farmers; a bonus of 10s. an acre was offered for areas of cotton grown as a pure stand, and seed cotton brought to the ginnery was purchased at 2d. a lb. Under this scheme 352 acres were planted and the bonus paid for 210 acres; 9,655 lb. of seed cotton were purchased as against 4,725 lb. in the previous season. Yields varied from 8 to 116 lb. per acre with an average yield of slightly less than 30 lb. per acre. The results were better than in the previous year, for with half the amount of seed distributed twice the quantity of cotton was brought in. The return to the farmer, however, was meagre, and consequently the purchase

and bonus scheme will be held in abeyance during the next season, and the efforts of the Department concentrated on investigational work.

"At Kpeve in Southern Togoland 20 acres of cotton were put down to cotton trials, similar to those carried out at Tamale. The purchase of seed cotton grown from the seed supplied by the Department was continued as in the previous years. In 1927, 514 lb. of cotton-seed were distributed, and in 1928 the Department purchased 6,616 lb. of seed cotton from the farmers receiving this seed. In 1928, 10,938 lb. of cotton-seed were distributed to over 60 villages and to a large number of individual farmers. Full details of the results of the trials and of the purchases under the extension scheme are not yet available, as the crop in Togoland ripens much later than in the Northern Territories. A cotton store was erected at Kpeve in May, 1928."

12. NORTHERN RHODESIA. *Future Prospects for Cotton.* (*Ann. Rpt. Dpt. Agr.*, 1928. Livingstone, 1929.) The policy of the Government is to limit the acreage under cotton until such time as a suitable variety of seed can be evolved for the Territory. With this object in view experiments are being carried out at the Research Station at Mazabuka in close liaison with departments of other Governments and with the stations of the Empire Cotton Growing Corporation. The Agricultural Department expresses its great indebtedness to the Corporation, which has seconded one of its officers for cotton selection work at the Research Station, and is also defraying half the salary of the agriculturist stationed in the Abercorn District. The assistance thus rendered is of the greatest value, and the results of the experiments are causing an increasing feeling of optimism that Northern Rhodesia may yet take her place among the cotton-producing colonies of the Empire. If cotton can be firmly established as a paying rotation crop, it will do much to increase the stability of the whole agricultural industry.

13. *Cotton Research Work at the Mazabuka Research Station.* (*Ann. Rpt. Dpt. Agr.*, 1928.) "The programme of work on cotton for the 1928-29 season includes provision for the conduct of observations in considerable detail upon the behaviour of the introduced varieties and their reactions to the climatic conditions, insect pests and diseases of the Territory.

"Provision exists in the cropping scheme for the growing at the Research Station of the following acreages of the varieties stated, for multiplication and as affording additional material for selection during the year:

U. 4 Ex Barberton, 1928	15 acres.
A. 12 „ „ 1927	3 „
U. 4-5 „ „ „	2 „
U. 4-6 „ „ „	2 „
Z. 1-9 „ „ „	2 „
Foster Whitehall Cross, Ex Nyasaland, 1927	1 acre.
Arizona	1 „

In addition, approximately 200 progeny rows of material selected from the above varieties and from the Station bulk of Improved Bancroft during the 1927-28 season are being grown. Further selections will be made from these and from the bulk crops during the present season.

"In order to obtain data relating to a wider range of conditions than are to be found on the Research Station itself, a series of small trial plots, in certain cases of 2 acres, and in others of 5 acres, has been arranged at six farms in the Territory—four at different elevations in the Mazabuka area, all easy of access from the Research Station, one in the Chisamba area, and one in the Monza area. These plots, which are all in localities in which the jassid attack has decimated the cotton crop in the past, are being run on ordinary commercial lines. The plots will be kept under observation by members of the staff at the Station;

they are, in each case, isolated from other cotton, and the produce will be available for multiplication of a particular variety should its behaviour warrant this, or will be available for a further series of trials next season."

14. *Cotton Cultivation.* (*Ann. Rpt. Dpt. Agr.*, 1928.) From the report of the agricultural officer stationed in the Abercorn district we learn that several attempts have been made to start cotton-growing among the natives, and seed was introduced and distributed. The most successful attempt is that of Mr. Ross of Kambole Mission, who started cotton-growing in the Luvu valley and got the natives in this part interested in the industry. The difficulty of establishing an industry like cotton-growing in this district, however, is the sparseness of the population, which is scattered all over the place in small villages. Cotton-growing on the Lake-shore area was also tried by some plateau farmers, but it proved a complete failure due to a very bad attack of Aphis followed by a worse one of Jassid.

This season there is no cotton being grown, but trial plots have been started in various likely parts, and from the experience and information gained, it is hoped that a suitable variety of cotton will be found, and if conditions prove favourable this industry will be encouraged. The Luvu valley and Lake-shore are possible areas, but there is only a small population of about 2,700. This part has the advantage of being near the Lake transport. The Luanga valley should prove a successful area, with a larger population—over 9,000—but there will be 200 miles of transport to get the cotton to the Lake.

15. Southern Rhodesia. *Cotton Cultivation: Hints to Growers.* By G. S. Cameron, Empire Cotton Growing Corporation. (*Rhod. Agr. J.*, xxvi., **9**, 1929, p. 883.) In this paper Mr. Cameron gives many useful hints to cotton-growers in Southern Rhodesia. It is considered that the U. 4 strain has been a success upon 80 per cent. or more of the sixty-eight plots tried on different farms. Seed of U. 4 is now being issued by Government at 1½d. per lb. to farmers who desire to give it a trial.

The actual hints refer to the following: Choice of land; fertilizers; time of planting; spacing; hand *v.* machine planting; dry planting; thinning; cultivation; hand weeding; picking; sorting.

16. Sierra Leone. *Quande Cotton.* From the *Ann. Rpt. of Lands and Forests Dept.*, 1928, recently received, we quote the following: "The selection of native cotton for greater length and better colour of lint has been in progress since early 1925. A steady improvement has been obtained, and the results have been confirmed by reports kindly furnished by the British Cotton Growing Association on samples supplied from time to time. During the year an attempt was made to increase some of the improved cotton to obtain information on its behaviour when sown in bulk. Unfortunately, an exceptional flood destroyed some of the plots and seriously damaged others. The selection plot, which was also flooded, withstood the conditions well, and was not seriously damaged. This year it is hoped to increase a number of improved strains."

17. South Africa. *Cotton Prospects.* (*Crops and Markets*, viii., **1**, 1929, p. 275.) "The low veld areas of Natal and the Eastern Transvaal have enjoyed early and excellent rains, and with ample supplies of the jassid-resistant U. 4 seed, conditions are most encouraging for growers to increase their cotton area this season.

"In his market notes of September 20, the Manager of the Central Co-operative Cotton Exchange expressed the following opinion: 'From a market point of view, prospects are distinctly good as far as our next crop is concerned. Nobody will grumble at an indicated price of 10½d. for our average South African cotton and 11½d. to 1s. for our best styles of Orange River cotton. We have no hesitation in urging our friends to put a full acreage to cotton this season.'"

[*Cf.* **Abstracts 58, 59, 60, 154.**]

18. SUDAN. *Cotton Cultivation.* (*Ann. Rpt. Cent. Econ. Bd.*, 1928-29.) *Gezira Irrigation Scheme.* The 1927-28 cotton crop yielded an average of 3·29 kantars of seed cotton over an area of 105,589 feddans. This was less than the yields of the two previous seasons, but it must be borne in mind that the yields of these first two seasons were exceptional and have always been recognized as such. The decrease was due chiefly to the exceptionally unfavourable climatic conditions, which encouraged pests. Good prices were obtained for the cotton. The scheme is as popular and prosperous as ever, and there are three times the number of applicants for any new tenancies available. Labour (60,000 to 70,000 natives are required annually for the picking) continues to be readily attracted, and is drawn from the White Nile and areas surrounding the Scheme, and from pilgrims passing through from West Africa. The programme of extensions to the canalized system made rapid progress, and some 77,200 feddans were completed and put under irrigation during the year.

Prospects for the 1928-29 season are very fair. The area under cotton has increased to 131,351 feddans, and a crop of 3·5 kantars per feddan is anticipated.

19. *Cotton Cultivation.* (*Monthly Rpt. Coml. Intell. Branch, Cent. Econ. Board,* xxiii., **10**, 1929, p. 246.) In Kassala Province the Gash flood has been larger than any previously recorded; it has reached the Haiya-Kassala railway some thirty miles north of Hadaliya station, and has broken the line. A certain amount of cotton has been lost from overflooding and the excessive growth of grass, but it is estimated that the total cotton area will amount to 40,000 feddans. The rain-grown crops of the Kassala district are reported to be excellent.

In Kordofan Province the reports on the cotton crop of the Talodi district are on the whole most encouraging. In Kadugli district the cotton crop has improved considerably.

Test Plots.—Ploughing the land for cotton has given very good results; also the effect of manuring cotton with fermented cotton-seed is very marked. The best cotton on the Experimental Farm is a plot which had an application of manure and was ploughed.

20. *Gezira Irrigation Scheme, Blue Nile Province.* (*Monthly Rpt. of the Coml. Intell. Branch, Cent. Econ. Board,* xxiii., **9**, 1929, p. 215.) The area planted with cotton amounts to 159,512 feddans, the greater part of which has been sown on rainfall only. All cotton so far is fairly free from pests. A brown rot due to excessive moisture has destroyed a certain amount of seedling cotton.

21. *Transport and Communications.* (*Rpt. on Finan. Admin. and Condition of the Sudan in* 1928, recently received.) One of the most potent influences on native life is the far-reaching development of communications which has taken place during the last five years. The new railways and, perhaps more than all, the motor vehicle, and a rapidly extending road system, are transforming native conditions, and though the changes that are taking place will give rise to those recurrent problems which are the penalty of progress, the balance is to the good.

The mileage of the new railways is:

Haiya-Kassala	215 miles.
Kassala-Gedaref	136 „
Gedaref-Makwar	144 „

The capital cost, including rolling-stock, is £E.2,852,750, of which about £E.2,086,000 has been expended in Great Britain.

With the advent of the motor-car a new and vital factor has come into the life of the country, and the whole question of motor transport and roads is receiving close attention. At present the motor haulage costs are too high except for the transport of a few high-priced articles, and a reduction in these, whether it be the outcome of mechanical inventions or of road improvement, is essential.

Nevertheless, large areas in the Sudan are rapidly becoming mechanized, and the radius of the main lines of communication has been definitely extended.

22. *Motor Transport.* (*Ann. Rpt. Cent. Econ. Bd.*, 1928-29.) The continued progress of the Gezira Irrigation Scheme and the extension of railways are obviously bringing about great changes in the economic life of the country, but in addition to these major developments the rapid increase in motor transport is exercising a new and potent influence. Socially and politically, this new form of transport—which appeals very strongly to the native, especially in the more sophisticated areas, where he is buying cars and lorries and going into the motor transport trade himself—must already have made itself felt to a considerable degree. Towns and outlying villages are being linked up, and many thousands of natives now have opportunities to travel which they never possessed before.

The future of cotton-growing in the far south depends almost entirely upon motor transport, and was practically non-existent and impracticable until the lorry enabled porterage to be dispensed with. In the early stages of the successful effort to grow cotton in the Nuba Mountains Province, motor transport was indispensable.

23. TANGANYIKA. *Cotton Experiments.* (*Bull. Imp. Inst.*, xxvii., 3, 1929, p. 367.) Experiments at Morogoro demonstrate the advantage of planting as soon as the rains begin. The highest yield appears to be obtained with 19,000 to 29,000 plants an acre. Variety trials and spacing, time of sowing, and ratooning experiments are also described.

24. UGANDA. *Cotton Cultivation.* From the *Ann. Rpt. of the Dpt. of Agr.*, 1928, recently received, we learn that, following the period of famine conditions which had prevailed in parts of the Eastern and Northern Provinces at the close of the previous year, and which continued for the first few months of 1928, the climatic conditions were favourable for the planting of food crops, and with these well established by May the preparation of land for cotton became general. The weather conditions during the sowing season were generally favourable except in Lango district, where abnormally heavy rains were experienced.

At the end of the year the prospects of a good crop were very promising, although in the northern parts of Teso district an outbreak of "blackarm" disease occurred, and cotton stainers were more numerous than usual. Damage was also caused by *Earias* spp. and *Aphis gossypii*, Glov.

During the year extensions of the Kenya and Uganda Railway from Tororo towards Soroti were under construction, and work was also started on the continuation of the line from Jinja to Kampala. Large numbers of motor lorries and light motor vans were again used for the collection and transport of the cotton crop to ginneries and markets.

No fresh sites for the erection of ginneries were granted during the year; 164 ginneries were licensed to gin and bale cotton, of which 146 actually worked.

The total number of ploughs in use in the Teso district was 3,400, an increase of over 450 compared with the previous year. Ploughing instruction is given by native instructors employed by the Department under supervision of a European Ploughing Instructor. In the Bugwere district over 1,700 ploughs are in use.

In the report of the Cotton Grader it is stated that the grade of raw cotton in the Eastern Province was slightly down, but the grade was better on the whole in the Buganda Province. Much damage was caused to the cotton by careless handling at the markets and at the railway stations.

The Cotton Botanist describes the experimental work carried out at the Serere Experimental Station, fuller details of which are given in the Empire Cotton Growing Corporation's *Reports from Experimental Stations*, 1927-28.

25. *Cotton Prospects.* The latest report from the Department of Agriculture is to the effect that the crop prospects in most districts are very satisfactory.

26. AUSTRALASIA: QUEENSLAND. *Cotton Cultivation.* (*Dalgety's Ann. Wool Rev.*, 1928-29, p. 156.) The weather conditions in Central Queensland have been distinctly against the cotton-growers for the 1929 season except in a few favoured spots. The drought of 1928 continued till late November, and planting was carried out extremely late for the forthcoming crop. The volume of rain that followed the drought was ample, and the more or less weekly falls caused great difficulty for the growers in the eradication of weeds; nevertheless the fibre is above normal in length, and a large proportion of it is strong and of good lustre. Early frosts in April damaged the top crop, and in some cases portions of the middle crop, which will not be harvested, and as far as can be estimated at present, the crop will not exceed 4,000 bales for the central district.

It is expected that the change of government in Queensland and its attitude in regard to perpetual leasehold will have a stimulating effect upon next season's crop, and the downward tendency of wheat prices will check the anticipated wheat-growing in the cotton section, and thereby increase the crop considerably.

Cotton prices have remained fairly stable, and with a large number of new farmers taking up land in the Callide area for this coming season, cotton prospects are considerably brighter than they have been for some time past.

27. *The Upper Burnett and Callide Valley: A New and Fertile Agricultural and Grazing Region.* (*Queensland Agr. J.*, xxxii., 1, 1929, p. 45.) In a report by the Land Administration Board it is stated that for the Callide Valley the matter of the survival of the cotton industry is of great importance, since the foundation of that district was based on the growing of cotton. Cotton originally attracted most of the settlers, and kept them going. The industry must surely and quickly decline unless means can be found to stabilize prices and ensure a reasonable return to the grower. Various proposals to help the growing and manufacturing industries have been submitted to the Commonwealth Government by the Queensland Cotton Board and by cotton manufacturers, and are under consideration.

28. WEST INDIES. COTTON REPORTS. (*West. Ind. Comm. Circ.*, xliv., 810 and 812, 1929.) *Anguilla.* "The Sea-Island cotton crop, if saved from insect pests, should be a very satisfactory one. The plants look healthy, and every prospect is favourable."

Montserrat.—According to a report from the Department of Agriculture the cotton crop as a whole shows decided improvement, though continuous rains fell for two weeks. The flowering and bolling are very heavy, and, apart from accidents, an excellent cotton crop should materialize.

Nevis.—Reports state that cotton yields are fairly good, and although there was a slight increase of pink bollworm, the pest has not been serious. The yield of cotton per acre has turned out very much better than anticipated, and when the crop has been reaped will probably be over 200 lb. of lint per acre.

St. Kitts.—The estimate for the cotton crop just reaped is 280,000 to 300,000 lb. of lint, and as the acreage planted was in the vicinity of 1,400 acres, the yield will work out at about 200 lb. lint per acre. There have been no local cotton sales, but there have been sales in Liverpool for this year's crop at prices ranging from 2s. 3½d. to 2s. 11d., which is very satisfactory.

29. COTTON-GROWING IN THE WEST INDIES. By J. A. Todd. (*West Ind. Comm. Circ.*, xliv., Nos. 811/2, 1929, pp. 423 and 449.) The post-war boom is described when some Sea Island reached 10s. a lb. Then followed the collapse, and the change over to Sakel, but things seem now to be improving a little. The author thinks that the West Indians are too greatly inclined to regard Sea Island as in a high-priced class by itself, which has no relation to the world price of cotton. The price of Sea Island, however, does bear a certain relation to that of the

varieties which come just below it on the scale, especially Egyptian Sakel. What is really wanted is a cotton that is a little better and not much dearer than Sakel.

30. HIGHER SEA ISLAND YIELDS: SIGNS OF A REAL REVIVAL. By J. A. Todd. (*Amer. Cott. Ann. Rev.*, August, 1929.) The author states that the average yield of cotton has been increased in many of the West Indian islands by the introduction of new and heavier yielding varieties, the adoption of different planting seasons, and control measures for the pink bollworm which seem to be meeting with substantial success. In these circumstances the position of the cultivator is sufficiently satisfactory to make an increased Sea Island crop possible if the world wants it, and is prepared to pay a price which will reasonably cover the cost of production, which is necessarily high on account of the great care required in the growth and handling of Sea Island cotton. There has recently been a slight but definite revival of interest in this cotton, due partly to the increased use of lace, but it is not possible to say if the demand will last, although the signs are encouraging.

COTTON IN EGYPT.

31. We have received from the Department of Overseas Trade a copy of the *Report on the Economic and Financial Situation in Egypt*, June, 1929, by R. M. Turner. Information is given regarding the cotton piece-goods market and cotton legislation, fixing the dates for announcing estimates of cotton acreage and of the cotton crop. The measures taken by the Government to improve the standard of purity of cotton, and Government loans to cultivators, are also dealt with. Appendices are included showing the exports of raw cotton in 1927 and 1928, the countries of destination, and the value in £E.

COTTON IN THE UNITED STATES.

32. RETROSPECT OF THE TOUR THROUGH THE U.S.A. COTTON BELT IN 1929. By N. S. Pearse. (*Int. Cott. Bull.*, viii., **29**, 1929, p. 99.)

33. AMERICAN COTTON: PRODUCTION AND CONSUMPTION. By J. A. Todd. (M/c. *Guard. Comm.*, 1929, xix., **447**. Abstr. in *Summ. of Curr. Lit.*, ix., **20**, 1929, M 23.)

34. COTTON: MARKETING IN U.S.A. By N. A. Olsen. (*Cotton*, M/c. 35, No. 1690, 1929. Abstr. in *Summ. of Curr. Lit.*, ix., **20**, 1929, M. 23.)

35. AMERICAN COTTON: ANNUAL REVIEW. The usual interesting and valuable review of all matters connected with the American cotton trade. The following articles, among others, are included: "A Helping Hand for the Salesman," by E. T. Pickard, dealing with new uses for cotton; "Review of the 1928-29 Season," by W. G. Reed; "Maximum of 15,000,000 Bales for 1929-30?" by C. T. Revere; "Consumption Prospects for 1929-30," by A. H. Garside; "The Weevil gets down to it," by Dr. G. D. Smith; "Crop and Price Relationships," by J. A. Todd; "A Square Deal for the Shipper," by Dr. A. B. Cox, dealing with the question of representation on arbitration boards; "Higher Sea Island Yields," by J. A. Todd.

36. AMERICAN COTTON: QUALITY IN 1928. By P. M. Strang. (*U.S. Dpt. Agr. Pamph.*, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **18**, 1929, M. 18.) An account is given of studies of the American consumption of cotton by grade and staple lengths. The domestic mills consumed approximately 6,800,000 bales during the year ending July 31, 1928, of which 6,500,000 were of American growth. More than 90 per cent. of the American cotton was white in colour, and

72 per cent. of it was middling or better in grade. The staple lengths consumed most extensively ranged from $\frac{7}{8}$ inch to $1\frac{1}{32}$ inches in length, of which 70 per cent. was $\frac{15}{16}$ inch or longer.

37. QUALITY OF COTTON GROWN IN GEORGIA. By W. T. Fullilove and W. B. Lanham. (*Bull.* 157, Exp. Sta., Ga., 1929.) Georgia produces practically as many bales of cotton as are consumed in the State, but the predominance of the shorter staple lengths in its crop makes it necessary for spinners to import approximately half of the cotton they consume. In other words, the production of the longer staples in the State is not in proportion to their consumption. The data for individual gins show that cotton fully one inch in staple length is grown in practically every county in the State. The quality of cotton grown in Georgia could be considerably improved if well-bred varieties and strains were grown throughout the State on naturally fertile soils or soils properly fertilized, and if the mixing of planting seed at the gins could be avoided.

38. THE FARM CREDIT SITUATION IN SOUTH-WESTERN ARKANSAS. By B. M. Gile. (*Bull. No.* 237, Agr. Exp. Sta., Univ. of Arkansas, 1929.) The factors affecting the economic employment of capital by farmers in south-western Arkansas are analyzed. The chief objective is to make available information that will aid farmers in correcting maladjustments in financing their business, and that will be useful to public and private agencies in providing credit on a sound and economical basis.

The main points dealt with are the following: The more important physical factors underlying the economy of farming in this district; the relation between owned and borrowed capital; the extent to which seasonal operations are dependent upon credit; the basis of farm credit in the district, as evidenced by the relation between money obligations and farm values and farm earnings of surveyed farms; the use made by farmers of recently established farm credit institutions; the term of farm loans in relation to the period for which borrowed capital is needed; current rates of interest compared with actual rates paid, and financial progress of farmers from the time they purchased their farms in 1927.

39. COST OF COTTON PRODUCTION IN THE UNITED STATES (1928). By W. Whittam. (*Text. Rec.*, xlvii., 558, 1929, p. 34.) A series of figures obtained in reply to a questionnaire sent out by the Division of Crop and Livestock Estimates of the U.S. Dept. of Agriculture. The cost varied from 7 to 52 cents. per lb., the lower figure going with higher yield per acre.

40. STATISTICAL INFORMATION CONCERNING COTTON SPINNING IN THE UNITED STATES OF AMERICA. Cotton Yarn Association Limited. (*J. of Text. Inst.*, xx., 8, 1929, T. 175.) Gives much valuable information under the following heads: Raw cotton production, acreage, yield per acre; Historical record of production; Changes in the acreage by States; Exports of raw cotton from U.S.A.; 1925 compared with 1900; Cotton yarn production, etc.; Yarn production by counts ranges; Cotton yarn imports; Period 1891 to 1918: General imports of cotton yarn with exporting countries; Cotton yarn exports; Manufacturing capacity of cotton cloth; Comparative statement of principal cotton goods produced in 1925; Imports of cotton piece-goods into U.S.A.; Effect of tariffs on imports of cloth into U.S.A.; Exports of cotton cloth; Labour employed.

41. "COMBED PEELER" AND "PEELER COMBER" COTTON: DEFINITION. (*Text. World* [U.S.], 76, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., 15, 1929, E. 22.) The terms "combed peeler" and "peeler comber," as loosely used at present, refer in the first case to any combed American cotton, and in the second to the waste of any combed American cotton. The word "Delta" is still being used by the trade synonymously with "peeler." The correct definition of all American cotton other than American Egyptian or Pima, and Sea Island, is Uplands. The only

accurate specification of the latter is by length and grade, although ⅞ inch and shorter cotton is usually defined as short cotton, longer than ⅞ inch and up to 1⅛ inches as premium cotton, and 1⅛ inches and longer Uplands as extra staples. The term "peeler" originally applied to what are now known as "extra staples," "combed peeler" being this cotton after combing, and "peeler comber" being the waste of such cotton.

42. Agronomic Experiments in New Mexico. (*New Mexico Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, lxi., 3, 1929, p. 219.) While single cotton plants 12 inches apart yielded 16 per cent. more than unthinned cotton, yields from 12 inches or wider spacing did not differ much. Cotton topped at three different dates did not yield very differently from untopped cotton. Cotton-seed from composited weekly ginnings (between October 8 and December 3) from different gins in the Rio Grande Valley had a rather uniform oil content over the period, averaging 24·1 per cent., while the protein content, averaging 23 per cent., tended to increase in the later weeks. The cotton-seed thus contained as much of the commercially valuable constituents at the end of nine weeks as at the beginning of the season. Storage of bales of cotton under various conditions in co-operation with the U.S. Department of Agriculture gave indications that cotton-bagging was in every way just as good as, if not superior to, the ordinary jute-bagging.

43. Field Crops Investigations in Tennessee. By C. A. Mooers *et al* (*Tenn. Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, lx., 2, 1929, p. 127.) Gives the results of varietal trials with cotton, corn, red clover, etc.; breeding work with cotton, corn, red clover and lespedeza; cultural (including planting) tests with cotton, corn, soybeans, and sweet potatoes; fertilizer tests with cotton; and crop rotations.

44. Cotton Research in North Carolina. (*Ann. Rpt. of Agr. Exp. Sta.*, 1928.) In inheritance studies with cotton it was shown that naked seed coat is dominant to fuzzy, and that less fuzz is dominant to more fuzz. Work is also going on in pure-line selection, spacing, times of applying fertilizers and ridging land, and cotton-seed treatment. In connection with the last-named we give the following extract: "One of the factors contributing to high yields of cotton is early planting. Early planting, however, increases the risk of a poor stand, and nearly every cotton-planter has repeatedly faced the problem of contenting himself with a poor stand or going to the added labour and expense of replanting. The greater portion of the reduction in stand of early planted as compared with later planted cotton is due to the killing of the seedlings by one or both of two fungi—namely, the anthracnose fungus (*Glomerella gossypii*) and the sore shin fungus (*Rhizoctonia*, sp.).

"With these losses in mind, tests have been undertaken in order to determine if seed treatment will not correct them in part at least. It was thought that the application of a coating of disinfecting dust to the surface of the cotton-seed before planting would prevent the killing of many of the seeds and seedlings, and thus a more nearly perfect stand might be obtained. Different lots of cotton-seed of the same variety were dusted before planting with a number of disinfecting materials such as mercuric chloride, copper carbonate, formaldehyde, and several proprietary products containing mercury in combination with phenol and its derivatives.

"The results of these tests are highly encouraging. In one field a careful count was made of the seedlings on the treated and untreated rows. Here the least effective treatment resulted in an increase of 95 per cent. in number of seedlings, while the most effective treatment increased the stand by 355 per cent. The average increase of stand in all treated rows over all untreated check-rows was 146 per cent. In still another field in which the stand on the rows planted to treated seed was estimated to be fair, the untreated portion of the field had to

be replanted. It is now believed that the use of these disinfecting dusts on cotton-seed will in many cases give sufficient protection to enable the grower to plant his seed from a week to ten days earlier than would otherwise be safe." Further tests are being made which will narrow the selection of dusting materials to the few of greatest merit.

COTTON CULTIVATION IN FOREIGN COUNTRIES.

45. Association Cotonnière Coloniale. We have received a copy of *Bull. No.* 88, 1929, containing articles upon cotton in Syria, Morocco, and other French colonies, and a number of statistics relating to French colonial production of the last two years.

46. Note sur les Progrès de la Culture du Cotonnier en Afrique-Occidentale Française. By W. L. (*Coton et Cult. Coton.*, iv., 2, 1929, p. 170.) Summarizes two recent publications: (1) "La situation actuelle de la culture cotonnière en Afrique-Occidentale Française," by E. Belime, and (2) "Rapport de Mission en A.-O.F.," by E. Hesling.

47. Cotton: Cultivation in French West Africa. By P. Schlumberger. (*Bull. Soc. Ind. Mulhouse*, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., 15, 1929, E. 22.) A general account of the development of cotton-growing in French West Africa under the direction of the Association Occidentale Française.

48. Italy. *Cotton Cultivation.* (*Cotton*, M/c., August 31, 1929.) The Italian Government has undertaken an extensive irrigation programme for the cultivation of cotton in the Plain of Tessenei near the border of the Anglo-Egyptian Sudan, and the waters of the Gash River will be used for irrigation. It is reported that this will make it possible to cultivate about 10,000 acres.

In Italian Somaliland, in the neighbourhood of Scebeli River, the annual production of cotton amounts to about 1,400 bales.

49. Societa Agricola Italo-Somala. (*Int. Cot. Bull.*, viii., 29, 1929, p. 75.) An account of cotton-growing in Italian Somaliland.

50. Cotton Investigations in Batangas and the Ilocos Provinces. By J. M. Ejercito and P. I. Cruz. (*Philippine Agr. Rev.*, xx., No. 1, 1929. Abstr. from *Exp. Sta. Rec.*, lxi., 4, 1929, p. 331.) Cultural methods are outlined and data given on production costs. Apparatus used in the native textile industry is illustrated.

51. Cotton Growing in Spain. By A. Sedo. (*Int. Cot. Bull.*, viii., 29, 1929, p. 53.)

52. Katoencultuur in Turkij. By W. Baron Rengers. (*De Indische Mercuur*, 13, 1929. Abstr. from *Int. Rev. of Agr.*, xx., 5, 1929, p. 191.) Cotton is the most important crop in Cenada (Anatolia) and in the Smyrna district. In these two areas there are respectively 800,000 and 38,000 hectares under cotton, the yields amounting to 100,000 and 15,000 bales. Rotation is biennial: first cotton, then wheat, then cotton again. Two kinds of cotton are grown, native and American, and 90 per cent. of the yield is given by the native variety. The best qualities come from the Smyrna district.

SOILS AND MANURES.

53. The Contributions of Glinka and the Russian School to the Study of Soils. By W. G. Ogg. (Reprinted from the *Scottish Geog. Mag.*, xliv., March, 1928. Rec. from the Edin. and E. of Scot. Coll. of Agr., 1929.) An

excellent account of the gradual development of soil science under the Russian school, which looks upon soils rather as due in their essential agricultural qualities to climatic conditions than to their geological derivation. The author summarizes the chief Russian contributions thus:

1. They have studied the soil as a natural object and not merely as a medium for growing crops, and hence have developed soil study as a separate science.

2. They have studied not only the surface layer but the whole soil profile down to the unweathered parent material.

3. They have recognized the differences brought about by climate in the structure, composition, and distribution of soils, and have developed a genetic classification based on climate.

4. They have developed a field technique by which soils may be differentiated in the field, and have made great contributions to soil geography.

54. The Effect of Drying on the Microbiological Processes in Soils. By Fahmy Khalil. (From the Dept. of Bacteriology, Coll. of Agr., Edinburgh, 1929.) *Summary:* (1) Drying considerably reduced the bacterial content of the soil, but on subsequent moistening and incubation, dried soils showed higher numbers than permanently moist soils. (2) Air drying caused a rapid conversion of ammoniacal to nitrate nitrogen. (3) Drying increased the nitrogen-fixing capacity of the soil (solution tests) and its ammonifying and nitrifying power (soil tests). (4) No evidence could be obtained in support of the view that the microflora of dried soils is more efficient than that of moist soils: (*a*) In ammonification and nitrification solution tests, when approximately equal numbers of bacteria were introduced, there was no difference in the ammonifying and nitrifying capacity of dried and moist soils; (*b*) Inoculation of dried soil with a filtrate from moist soil did not reduce its ammonifying and nitrifying power (soil tests); (*c*) The drying of partially sterilized soil (subsequently reinoculated) increased its ammonifying and nitrifying capacity (soil tests). (5) Drying renders the soil organic matter more easily decomposable: (*a*) The organic matter in dried soil was more rapidly ammonified and nitrified than that in moist soil; (*b*) Soils to which organic matter had been added before drying showed greater increases in microbiological activity as a result of drying than soils which had received no addition. (6) For normal soils soil extract agar and glycerine nitrate agar gave higher bacterial numbers than Thornton's medium. The latter gave the highest results for soils incubated after treatment with hydrocyanic acid gas.

55. A New Method of Dispersing Soils for Mechanical Analysis. By A. N. Puri. (*Agr. J. Ind.*, xxiv., 5, 1929, p. 330.) *Description of the Method.*—10 to 20 grm. of soil are left with 100 to 200 c.c. of N NaCl for about half an hour with occasional stirring. The suspension is then filtered and washed with about 500 c.c. of the same solution on the filter paper. It is finally washed with a few c.c. of $\frac{N}{10}$ NaCl solution, and when the whole of it has been drained off the remaining quantity is displaced with 10 to 20 c.c. of water. The suspension is then transferred to a stout beaker with 300 to 500 c.c. of water, and $\frac{N}{10}$ NaOH gradually run in till it is alkaline to phenolphthalein (used as an external indicator). The suspension is then mechanically shaken for one hour or left for five to six hours with occasional hand shaking.

Mechanical shaking or rubbing with a rubber pestle seems to be essential for certain red soils; for all other soils it could be dispensed with.

It is not necessary to use pure NaCl for replacement; sodium chloride containing not more than 1 per cent. calcium or magnesium salts is equally effective, and can be easily prepared from ordinary common salt by adding Na_2CO_3. When

the bulk of calcium and magnesium salts is precipitated the excess of Na_2CO_3 is then just neutralized by adding dilute HCl.

The details of the method can be varied to suit individual taste; what is required is to replace all or at least a greater part of the exchangeable ions by sodium in the clay complex.

There is practically no loss of soil constituents involved, and a more rational picture of the size distribution of the various particles is obtained by this method than by the acid treatment.

56. New Cylinder for Separating Fine Soil Particles by Decantation. By L. Smolik. (*Bull. Czechoslovak Acad. of Agr.*, Prague, vol. ix., 5, 1928. Abstr. from *Int. Rev. of Agr.*, xx., 7, 1929, p. 260.) A new decantation cylinder planned by the author for the mechanical analysis of lands. An improvement of the Atterberg apparatus in respect of the lateral discharge pipe and the vertical graded measure intended to measure the time of decantation.

57. A New, Simple, and Rapid Method for Determining the Moisture Equivalent of Soils, and the Rôle of Soil Colloids on this Moisture Equivalent. By G. J. Bouyoucos. (*Soil Sci.*, xxvii., 3, 1929. Abstr. from *Int. Rev. of Agr.*, xx., 7, 1929, p. 260.) A new method of determining the "moisture equivalent" of soils, based on elimination of the water by diminution of pressure in place of centrifugal force, and giving more certain results, which reveal a close correlation between the "moisture equivalent" and the rate of colloidal substances in the soils. A photograph is given of the apparatus employed.

58. Official Soil Map of the Union of South Africa. (*Sci. Bull. No.* 79, Div. of Chem., Ser. No. 94, Dept. of Agr., South Africa, 1929.) A valuable guide for all proposing to begin agricultural operations in South Africa. A good map is given of the distribution of the various types of soil, with full explanations.

59. Routine Mechanical Analysis of Soils by the Robinson Method. By Dr. J. P. van Zijl. (Div. of Chem., Ser. No. 97, Pretoria, 1929.) Deals with the subject under the following main headings: Preparation of Soil; Method of Analysis; Plotting of Curves.

60. The Soil Solution and its Relation to the Soil Colloids. By D. J. R. van Wijk. (Div. of Chem. Ser., No. 95, Pretoria, South Africa, 1929.) Describes the following experiments carried out by the author: (*a*) Experiments in which nitrate and chloride determinations were made in the soil extract; (*b*) Determinations of the depression of the freezing-point of the water forming the soil solution; (*c*) Determination of chlorides in the soil solution obtained by an artificial root.

61. Relation of Temperature to the Amount of Nitrogen in Soils. By H. Jenny. (*Soil Sci.*, xxvii., 3, 1929. Abstr. from *Int. Rev. of Agr.*, xx., 7, 1929, p. 261.) Investigations on relations between soil temperatures and nitrogen content, carried out in U.S.A. In the non-arid regions there is an inverse correlation between the average annual temperature and the average content in nitrogen of different soils; with each fall of 10° C. there is a two to threefold increase of nitrogen in the soil; on the other hand, when the temperature increases, the relation C : N in the organic matter seems to become closer.

62. Fertilizer Experiments with Cotton. By J. T. Williamson. (*Alab. Sta. Bull.*, 228, 1929. Abstr. from *Exp. Sta. Rec.*, lxi., 2, 1929, p. 130.) Co-operative fertilizer experiments with cotton from 1911 to 1922 showed conclusively that, with the possible exception of the Piedmont Plateau, the soils of Alabama should be treated with a complete fertilizer, and that a safe minimum application

for cotton per acre is 100 lb. of sodium nitrate, 200 lb. of superphosphate, and 25 lb. of potassium chloride. Based on these results, later tests (1923-1927) were made to determine the value of further increments of each of the nutrient materials. Best returns usually were obtained when 650 lb. per acre of a mixture in the above proportions was used.

63. EFFECT OF FERTILIZERS ON THE SIZE OF COTTON BOLLS. By P. Bartholomew and G. Janssen. (*J. Amer. Soc. Agron.*, xx., **10**, 1928. Abstr. from *Coton et Cult. Coton.*, iv., **2**, 1929, p. 153.) The action of manures shows itself not only in increasing the number of capsules, but also in increasing their dimensions and the percentage of lint.

64. ACTION DE LA FUMURE SUR LES RENDEMENTS DU COTONNIER ET LA QUALITÉ DE SES FIBRES. By F. Heim de Balsac and E. Miege. (*Coton et Cult. Coton.*, iv., **2**, 1929, p. 97.) Experiments in Morocco show that the use of manure is needed to bring out the best maturation of the fibre.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

65. COTTON SEED: DELINTING FOR PLANTING. By V. U. Cloer. (*Chem. Abs.*, 1929, **23**, 4011. Abstr. from *Summ. of Curr. Lit.*, ix., **19**, 1929, E. 29.) A mass of seed in dry condition in an enclosed space is subjected to the action of halogen acid gas under pressure; after removal from the acid atmosphere the seed is heated to about 82°-99° and agitated to remove the lint. An apparatus is described. The acid treatment serves to facilitate separation of heavy seed from lighter seed.

66. EFFICIENCY STUDY OF ONE- AND TWO-HORSE CULTIVATORS IN COTTON PRODUCTION. By C. B. Williams. (*Ann. Rpt. Agr. Exp. Sta., N. Carolina*, 1928, p. 43.) The greatly increased use of two-horse riding cultivators has raised questions regarding their efficiency as compared with the common one-horse type. Experiments were carried out to test the ability of each cultivator to thoroughly cultivate the cotton crop, and the relative cost in man and horse labour.

The four cultivations needed by the crop were all carried out, and the time consumed in the cultivation of equal areas by each machine was found to be exactly twice as great in the case of the one-horse as in that of the two-horse implement. With man labour at 20 c. per hour and horse labour at 15 c. per hour, the labour cost per acre cultivated was 40 per cent. greater with the one-horse type.

67. GINNING TECHNIQUE AND THE QUALITY OF COTTON. (*Man. Guar. Coml.*, October 10, 1929, p. 425.) Describing the work now being carried out officially in the United States to determine the effect of the various factors that influence the result when cotton is put through the gin. It is pointed out that there are several thousand distinct combinations of conditions employed. The object of the work is to determine the best combinations, and to eradicate as far as possible the apparent imperfections in ginning practice.

68. GREEN COTTON: EFFECT OF STORAGE BEFORE GINNING. (*Cotton*, M/c. 35, No. 1687, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **19**, 1929, E. 29.) In a warning by the South Carolina State Warehouse Commissioners to farmers against ginning cotton too soon after picking, it is stated that storage for sixty days not only enabled a greater weight of cotton to be obtained from seed cotton, but the cotton cleaned better, and had, in addition, "time to draw oil from the seed, which helped the grade. The oil adds to the spinning strength of the staple."

[*Cf.* **Abstract 526**, vol. vi., p. 353.]

69. Cotton Gin Fires: Prevention. By H. E. Raethe. (*U.S. Dpt. Agr., Circ. No.* 76, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., 19, 1929, E. 29.) The causes of fires in cotton gins are discussed, and thirteen rules for their prevention are given. Static electricity is the principal cause, and all metal and moving parts of the gin should be thoroughly earthed.

70. Cotton-Seed Meal as a Cattle Feed. (*Kansas Sta. Bien. Rpt.*, 1927-28. Abstr. from *Exp. Sta. Rec.*, lxi., 2, 1929, pp. 158 and 167.) Calves wintered on ground cane fodder *ad lib.* and 1 lb. of cotton-seed meal per day gained 1·31 lb. per head daily, while a second lot receiving cane silage *ad lib.* and 1 lb. of cotton-seed meal gained 1·3 lb. per head daily.

A group of heifers wintered for 180 days on cotton-seed meal and sorgo silage gained at the rate of 1·44 lb. per head daily, while a similar lot wintered on alfalfa hay and silage gained 1·13 lb. per head per day. While the breeding efficiency was low in both lots, there was no significant difference in this factor, lot 1 being bred an average of 4·3 times and lot 2 3·5 times.

71. Cotton-Seed Meal as a Feed for Dairy Calves. By O. E. Reed *et al.* (*J. Dairy Sci.*, ii., 6, 1928. Abstr. from *Exp. Sta. Rec.*, lxi., 3, 1929, p. 262.) Injurious effects resulted from the use of too great a proportion of cotton-seed meal. Experiments indicated that as much as 2 lb. of cotton-seed meal per day may be fed without injury to calves five months old or older when plenty of good hay and silage are also fed.

72. Linseed and Cotton-Seed Meal for Fattening Steers. (*Wisconsin Sta. Bull.* 405, 1929. Abstr. from *Exp. Sta. Rec.*, lxi., 2, 1929, p. 161.) Based on the results of three years' study by Fuller and Roche, the conclusion is reached that when cotton-seed meal is as much as $8 per ton lower in price than linseed meal, it is economical to replace one-half of the linseed meal supplement with cotton-seed meal for fattening young cattle.

73. The Efficiency of Cotton-Seed Meal and Representative New Mexico Roughages for Fattening Lambs. (*New Mexico Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, lxi., 3, 1929, p. 259.) The highest daily gains were obtained in lots fed either corn, cotton-seed meal, and alfalfa or cotton-seed meal and alfalfa. The cost of gains was cheapest in lots receiving cotton-seed meal and cotton-seed hulls, but the shrinkage in shipping was greater and the finish was poorer in these lots.

74. Swine-Feeding Investigations. (*Kansas Sta. Bien. Rpt.*, 1927-28. Abstr. from *Exp. Sta. Rec.*, lxi., 2, 1929, p. 162.) Cotton-seed meal was found to be less satisfactory than tankage as a protein supplement to corn and alfalfa pasture in producing gains and finish, while the addition of ground limestone or bone meal did not materially increase the value of cotton-seed meal. For winter feeding in dry lot cotton-seed meal was decidedly inferior to tankage. Adding bone meal during dry-lot feeding materially increased the value of cotton-seed meal, while the addition of ground limestone had practically no beneficial effect. Cotton-seed meal was found to be more efficient as a protein supplement to alfalfa pasture than alfalfa hay.

DISEASES, PESTS, AND INJURIES, AND THEIR CONTROL

75. Insect Nutrition. By B. P. Uvarov. (*Trop. Agriculture*, vi., 11, 1929, p. 319.) "In the *Transactions of the Entomological Society of London*, 1928, Pt. 2, Mr. B. P. Uvarov, senior assistant in the Imperial Bureau of Entomology, has brought together the results of all the work done on the subject of insect nutrition and metabolism. His memoir takes the form of an admirable introduc-

tory survey (65 pp.) of the range of problems involved, together with a bibliography of nearly 600 titles. In the collation and examination of so large a mass of literature, the author has done a substantial service to entomology and laid the basis and provided a guide for future research." (A. D. Imms, *Nature*, vol. 123, No. 3110.)

76. A Bioclimatic Zonation for Studying the Distribution of Injurious Insects. By W. C. Cook. (*Ecology*, x., 3, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 10, 1929, p. 550.) Three bioclimatic zones are described: (1) The zone of normal outbreak conditions, where outbreaks would occur yearly, but are controlled by variations in the climate; (2) the zone of occasional outbreaks; (3) the zone of possible outbreaks, where conditions are still further removed from the normal.

77. La Destruction des Insectes par les Rayons "Ultra-Violets." By G. Gourdon. (*Rev. Agriculteurs, Fr.*, 1929, No. 6 *bis*. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 10, 1929, p. 571.) An apparatus for trapping insects is described, which differs in minor details from that already noticed (*cf.* Abstract 601, vol. vi., p. 366). The author considers that the insects are attracted to the trap by the ozone formed in the air by the action of the ultra-violet rays from the lamp, and are subsequently benumbed by it.

78. "Neoton": What it Means to Agriculturists. (*Tokyo, Inst. Phys. Chem. Res.*, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 10, 1929, p. 547.) A proprietary insecticide prepared from rotenon, the active principle of derris root.

79. Ein neuartiger Verstäubungsapparat für die Schädlingbekämpfung mittels Flugzeugs (A New Dusting Apparatus for Combating Pests from an Aeroplane). By — Kienitz. (*NachrBl. deutsch PflSchDienst.*, ix., 6, Berlin, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 10, 1929, p. 576.) A very fine, uniform distribution of a dust insecticide from an aeroplane is achieved by forming the bottom of the container of a series of six parallel, diagonally fluted rollers set slightly apart so as to leave gaps a few millimetres wide. Under the rollers there are six slats that can be opened and closed by means of a lever to regulate the amount of dust released. The dust in the container rests on the rollers, only a little falling through on to the slats; the latter do not therefore bear any appreciable weight. The rollers are revolved by worms on a shaft geared to the motor. The dust is thus thrown on the slats and is distributed by them.

80. Preliminary Studies regarding Physical Qualities and Distribution of Sodium Silicofluoride Dusts. By W. E. Hinds. (*J. Econ. Ent.*, xxii., 5, 1929, p. 768.) Field experimental work with sodium silicofluoride dust applications applied to corn and sugar-cane for control of the sugar-cane borer has been conducted at the Louisiana Experiment Station during the seasons 1925, 1926, and 1927. The method of comparing the various brands of these dusts is described, and the results obtained in a series of twenty-four tests with eight different materials are shown. The study includes comparisons of the quantity of dust deposited per 1,000 square inches of area at points located at 15, 30, 45, 60, and 90 feet from the outlet of the dusting machine. The character of particles deposited is shown visually through micro-photographs with a magnification of sixty-four diameters, and photoprints made for the dust sample at each distance. Chemical analyses are also included, which indicate considerable separation of the sodium silicofluoride particles from hydrated lime particles when such a mixture is blown out and spread by air current to a considerable distance.

81. Boll-Weevil Control by Airplane Dusting. By F. L. Thomas *et al.* (*Bull. Texas Exp. Sta.*, 394, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A,

Pt. 9, 1929, p. 522.) The use of airplanes for the distribution of calcium arsenate on cotton is briefly reviewed. In Texas, the area so treated has increased from 3,000 acres in 1925 to approximately 50,000 acres in 1928.

82. Thermotropism of the Mexican Cotton Boll Weevil. By E. F. Grossman. (*J. of Econ. Ent.*, xxii., 4, 1929, p. 662.) A new apparatus for determining the thermotropic reaction of insects is described. The Mexican Cotton Boll Weevil (*Anthonomus grandis*, Boh.) showed definite orientation in response to 26° F. at the chilled and 130° F. at the heated end of the apparatus respectively.

83. Experiments on the Relation between the Location of Cotton Fields and the Intensity of Boll-Weevil Infestation the Succeeding Season. By E. W. Dunnam. (*J. Econ. Ent.*, xxii., 5, 1929, p. 750.) Data collected during 1928 at Tallulah, La., following the floods of 1927 with attendant restriction of cotton culture, tend to show that there is no relation between the distribution of the boll-weevil infestation in 1928 and the location of the cotton plantings in 1927.

84. Organization and Progress of Pink Bollworm Research Investigations. By B. R. Coad. (*J. of Econ. Ent.*, xxii., 5, 1929, p. 743. Geneva, New York.) The pink bollworm having become sufficiently abundant in extreme South-west Texas to permit of research investigations, the Bureau of Entomology, in co-operation with the Texas State Experiment Station, has inaugurated a series of studies dealing with all possible phases of life history and biology in that territory. Headquarters of this work are at El Paso, Texas, with several field laboratories in South-western Texas and Northern Mexico. Some of the most interesting results so far have been in connection with the migratory habits of the species, and it has been found that the moths have a distinct migratory period, starting about the 1st of September and continuing until frost. Airplane collections showed moths present at considerable altitudes in the upper air, and it is evident that wind transportation may be an important factor in spread.

85. The Airways of the Pink Bollworm: Tracking the Pest of the American Cotton Field. By J. A. Todd. (*Man. Guar. Coml.*, October 24, 1929.) An interesting article, showing the way in which the American entomologists have worked out the routes followed by this pest, and the measures that are being adopted to combat it. A map is included.

86. Combating the Pink Bollworm. (Trans. title.) By H. Besse and T. Pagliano. (*Dir. Gen. Agr. Com. et Colon. Tunis. Bull.* 32, 1928, No. 132. Abstr. from *Exp. Sta. Rec.*, lxi., 3, 1929, p. 253.) This is a report on fumigation of cotton seed for destruction of the pink bollworm. Carbon disulphide at the rate of 400 gm. per cubic metre for a period of from twenty-four to forty-eight hours was found to destroy the pink bollworm in the seed. Carbon tetrachloride at the rate of 600 gm. per cubic metre appears to be less effective.

87. Experiments on the Control of the Pink Bollworm in Egypt. By N. W. Barritt. (*Bull. Ent. Res.*, xx., 1, 1929, p. 503. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 9, 1929, p. 503.) No significant change in extent of attack appears to have resulted from the vigorous methods of control adopted by the Government, which include the compulsory ginning of all seed cotton before May and heat treatment of all seed. Figures given by Williams on the seasonal variation of this pest from 1916 to 1924 show that the attack begins with about 5 per cent. infestation at the beginning of July, increases to 15 per cent. in the first week of August, and rapidly rises to 60 or 70 per cent. in the first week of September, after which every boll is attacked. It seems probable that this is due to the natural rate of increase of the insect when an abundant supply of

bolls is available, and that the occurrence of only a few moths in each locality in June is sufficient to produce 100 per cent. attack in September. Thus, although 98 per cent. of the hibernating larvæ may be killed by the control measures, the existence of larvæ or pupæ in fallen bolls buried in the soil or in bolls on cotton sticks stored for fuel is quite sufficient to start the outbreak in July. Unfortunately it has not been found practicable to destroy these bolls, and the adoption of some control measure during July and August appears desirable. Experiments were carried out with a castor-oil-resin emulsion used as a deterrent to oviposition. The results are inconclusive, but suggest the feasibility of control along these lines, and the possibility of employing a protective belt of sprayed plants in fields that have not recently carried a cotton crop, and in which buried bolls are not a source of infestation.

88. THE INTRODUCTION OF A PARASITE (*Microbracon kirkpatricki*, Wilk.) OF THE PINK BOLLWORM INTO EGYPT. By A. Alfieri. (*Bul. Soc. R. Ent. Egypte*, 1928. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 9, 1929, p. 541). Details are given of the introduction of the Braconid *Microbracon kirkpatricki*, Wilk., from Kenya, where it is an efficient parasite of *Platyedra gossypiella*, Saund. (Pink Bollworm), into Egypt. Most of the parasitized bollworms were found to occur in green, half-opened bolls; 10 to 12 per cent. of these bolls contained parasitized material, an average of four parasites emerging from each.

89. PINK BOLLWORM (*Platyedra gossypiella*, Saund.) IN THE GEZIRA DISTRICT OF THE SUDAN IN 1927 AND 1928. By H. B. Johnston. (*Bull. No.* 26, Ent. Sect. Welcome Trop. Res. Labs., Sudan, 1929.) The years 1927 and 1928 were marked by a higher rate of infestation by pink bollworm in the Gezira cotton crop. An average of 3·8 per cent. was observed in 1927, and 24·1 per cent. in 1928. In view of this increase a determined effort was made by means of legislation, propaganda, and house-to-house search, to obtain as much as possible of such seed as would neither be exported from the district directly after ginning nor be treated by sunning, and it is believed that a very large proportion of this seed was destroyed. Investigations on samples from various sources showed no living larvæ in seed which had been exposed to high temperature in the open, but seed from buildings produced larvæ in the majority of cases. It is probable that the majority of these living larvæ were of the short-cycle generation, and that the number of long-cycle moths produced in the Gezira is small. It is considered that the best means of killing all resting larvæ is to sun the seed at 62° C. for two hours.

90. ANNUAL REPORT OF THE ENTOMOLOGIST TO THE GOVERNMENT, PUNJAB, LYALLPUR, 1927-28. By M. A. Husain. (*Rpt. Dpt. Agr., Punjab*, 1927-28, Pt. II., vol. i., p. 55. Lahore, 1929.) *Cotton Pests.*—Attention was chiefly devoted to work on the pink bollworm, and the following investigations were continued: (1) Correlation of climatic factors with the incidence of *P. gossypiella*, in seed stores; (2) influence of temperature and humidity on resting larvæ and their emergence; (3) climatic conditions which control the distribution of pink bollworm in the Punjab. Research was also carried out on the Cotton Stem Borer (*Sphenoptera gossypii*) and Spotted Bollworm (*Earias insulana*). *E. insulana* is parasitized by *Elasmus* sp. *Rhogas testaceus*, Grav., *Melcha nursei*, *Chalcis tachardiæ*, and a new Tachinid. In addition to the above-named pests, certain minor pests, such as *Tarache notabilis*, *T. nitidula*, *T. bisefra*, *Sylepta derogata*, *Laphygma exigua*, *Phycita infusella*, and *Cosmophila erosa*, were under observation. The following insects were also found on cotton during the year: *Colasposoma pulcherrimum*, *Heliothis obsoleta*, *Euproctis fraterna*, *Pœcilloceras pictus*, *Psychid larvæ*, *Cecidomyia*, *Syntomid larvæ*, *Anobliidæ* (*Ptinidæ*).

91. THE MYSTERY OF *Alabama argillacea*. By G. N. Wolcott. (*Amer. Nat.*, **63**, No. 684, 1929. Abstr. from *Exp. Sta. Rec.*, lxi., **4**, 1929, p. 357.) This discussion of the migratory habits of the cotton leaf-worm is based upon personal observations in the United States, the West Indies, and Peru.

92. AN ADDENDUM TO MR. F. D. GOLDING'S "NOTES ON THE BIONOMICS OF COTTON STAINERS (*Dysdercus*) IN NIGERIA." By W. E. China. (*Bull. Ent. Res.* xx., Pt. 1., p. 38, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 9, 1929, p. 502.) In Golding's paper on *Dysdercus* spp. occurring in Nigeria, it was suggested on the author's authority that the identity of three species was doubtful. Since that time he has examined Golding's material, and now states definitely that the specimens of *D. nigrofasciatus*, Stal, and *D. migratorius*, Dist., taken in Nigeria were correctly identified, but that *D. intermedius*, Dist., does not, so far as is known, occur there. To the species recorded by Golding from that country, *D. antennatus*, Dist., must be added, although it is probably generically distinct from typical species of *Dysdercus*.

[*Cf.* Abstract **576**, vol. v., p. 348.]

93. PARIS GREEN FOR CUTWORM BAITS. By C. Lyle. (*Quart. Bull. Mississippi Pl. Bd.*, viii., **4**, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 9, 1929, p. 524.) **94.** FURTHER TESTS OF CUTWORM BAIT POISONS. By C. Lyle. (*J. Econ. Ent.*, xxii., **5**, 1929, p. 797.) In tests carried out in Mississippi during 1928 on *Agrotis ipsilon*, Hufn., *Prodenia ornithogalli*, Guen., *Laphygma frugiperda*, S. and A., *Feltia annexa*, Treit, and *F. malefida*, Guen., with cutworm bait in which the insecticides were used at the rate of 1 lb. to 50 lb. bran, the average mortality secured was 95 per cent. with Paris green in twenty-four hours, in comparison with 53·6 per cent. kill with a sodium fluosilicate bait of the same proportions. When the sodium fluosilicate was completely dissolved in water before adding to the bran, the mortality was 44·8 per cent. in twenty-four hours. A bait containing 1 lb. Paris green to 50 lb. wheat bran moistened with water is therefore recommended, to be applied broadcast at the rate of 10 lb. dry weight to the acre. This bait should be distributed in the late afternoon a day or two before plants are set in fields where cutworm injury is expected.

[*Cf.* Abstr. **248**, vol. vi., p. 198, and abstr. **106** below.]

95. THE VALUE OF SPRING EMERGENCE RECORDS ON THE COTTON FLEA-HOPPER, *Psallus seriatus*. By H. J. Reinhard. (*J. Econ. Ent.*, xxii., **5**, 1929, p. 765.) The occurrence of destructive cotton flea-hopper, *Psallus seriatus*, infestations on cotton apparently is determined by the status of the current crop at the time when the peak of spring emergence of the insect occurs. In the two seasons 1927 and 1928, when the maximum number of insects emerged during March, at which time very little young cotton was available in the field, little or no injury to the crop by this species was produced. During the spring, 1926, the peak of emergence occurred about April 15, after cotton was up generally to a stand in the field, and extensive injury by this species to the crop resulted in many sections of the State.

96. COTTON WHITE FLY: OCCURRENCE AND CONTROL. By R. B. C. S. Misra and K. S. Lamba. (*Agr. Res. Inst., Pusa, Bull. No.* 196, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **19**, 1929, E. 29.) The cotton white fly (*Bemisia gossypiperda*) is described in full. It was noticed for the first time on cotton in Bihar in 1905, and was then, as now, observed to be present more on the broad-leaved varieties than the short-leaved ones. Of late it has been much in evidence on cotton, and especially in the Punjab.

97. THE UNEVEN DISTRIBUTION OF *Heliothis obsoleta*, F. ON COTTON IN TEXAS. By R. K. Fletcher. (*J. Econ. Ent.*, xxii., 5, 1929, p. 757.) Some of the possible causes for the uneven distribution of *Heliothis obsoleta* on cotton are briefly considered. These are rainfall, soil, the possible attraction of the moths to cotton plants because of an increased secretion of nectar in certain localities, or their possible attraction to cotton covered with honey-dew.

98. RESPONSE OF THE ORIENTAL PEACH MOTH AND CODLING MOTH TO COLOURED LIGHTS. By A. Peterson and G. J. Haeussler. (Abstr. from *Anns. of Ent. Soc. of America*, xxi., 3, 1928, p. 353.) *Summary.*—The authors appreciate the fact that this investigation has not been as thorough and as exhaustive as it might have been, but so far as the results go most of the information which we were seeking was obtained. Since further work along this line will not be conducted in the near future, we have decided to publish the more important facts learned. It is hoped that these may be of some assistance to investigators interested in this problem or those of a similar nature. The following are some of the more important conclusions.

Oriental peach moths and codling moths seek the light side of containers in which they are placed. This indicates that they are positively phototropic under ordinary circumstances.

When adults of both species, under laboratory conditions, are placed in pieces of apparatus similar to the ones employed in the tests, the following responses occur. When all compartments, particularly in a four-way apparatus, are equally lighted with white lights, an equal (approximately) number of adults of both species will go into each chamber. When the compartments are unequally lighted with electric bulbs varying in strength between 10 and 100 watts, the largest number of moths will go to the strongest light.

If moths of both species are given the choice of lights varying in colour from red to violet, and the ratios of (relative) intensities of the coloured lights are approximately equal, practically all of the moths will go to blue and violet coloured lights. Orange and yellow lights are unattractive when compared with bluish lights. Green light, possessing no blue rays, is also unattractive. Violet light is preferred to blue, and purple ultra lights appear to be more attractive than violet. It is probable that ultra-violet light is seen by oriental peach moths and that they are attracted by it. Codling moths appear to be somewhat more positively phototropic to blue and violet lights than oriental peach moths. So far as observed, the response of males and females of the two species to coloured light appears to be similar.

The results in the four-way apparatus in the great majority of the tests where comparative lights are placed opposite or at right angles to each other, are as follows: When a weaker or less attractive coloured light (X) is placed at right angles to a stronger or more attractive coloured light (Y), a greater number of moths go to the weaker or less attractive coloured light (X) than when such light (X) is placed opposite a stronger or more attractive coloured light (Y).

Very few oriental peach moths come to ordinary white or artificial daylight electric lights in a peach orchard. Electric light traps have been used by a fruit-grower for two or more seasons, and have proved to be of little or no value in controlling the oriental peach moth.

99. HARLEQUIN BUG. By B. B. Fulton. (*Ann. Rpt. Agr. Exp. Sta., N. Carolina*, 1928, p. 90.) A large number of laboratory tests were made on the harlequin bugs, using every kind of material available that might have value as a contact insecticide. A technique was worked out to insure uniform results in the experiments. Insecticidal soaps gave the best results at first, but it was later found that many of the common laundry soaps killed even better than the insecticidal soaps.

Under conditions of high evaporation a 2 per cent. soap spray is less effective than a one-half per cent. in a saturated atmosphere. Spraying in the field on bright, dry days gave poor results, but during humid weather the effectiveness was limited only by the cover protection afforded by the plants.

100. Effects on the Cotton Plant of the Feeding of Certain Hemiptera of the Family Miridæ. By K. P. Ewing. (*J. Econ. Ent.*, **22**, 1929, p. 761.) Experiments with six of these (*Psallus seriatus, Lygus pratensis, L. apicalis, Adelphocoris rapidus, Creontiades debilis*, and *Pœciloscytus basalis*) showed that when they fed on cotton the young squares were shed or became blasted, and lesions were produced on stems and petioles, also mutilations of leaves.

101. On the Question of the Biology of the Yellow Thrips and its Control in Cotton Fields. (In Russian.) By S. Fedorov. (*Khlop. Dielo*, viii., **3**, 1929. Abstr. from *Rev. App. Ent.*, Ser. A, Pt. 8, 1929, p. 477.) The control measures recommended comprise a rotation system in the cultivation of cotton. This should include the growing of graminaceous plants, including millet, and sowing these for two consecutive years should prove very effective. A single application of soap solution has only a temporary effect, as it kills the larvæ and the adults on the leaves, but does not affect the eggs in the parenchyma, and the plants soon become reinfested; a second spray must therefore be applied after an interval of four to five days. Careful destruction of weeds and removal of trash after cotton harvest are useful supplementary measures.

102. The Aphids of Central Asia. By V. P. Nevskii. (In Russian.) (Uzbekistan Exp. Plant Prot. Sta., Pubn. No. 16, Tashkent, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 10, 1929, p. 586.) *Aphis flava* is recorded on the lower surface of the leaves of cotton.

103. Variation in Resistance of Aphids to Toxic Sprays. By N. Turner. (*J. of Econ. Ent.*, xxii., **2**, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 8, 1929, p. 446.) An account is given of a series of tests carried out to determine the variations in the resistance of aphids to 40 per cent. nicotine sulphate 1 : 800. A simple method of applying contact insecticides by an adaptation of the Tattersfield apparatus is described. Among the seven species subjected to test, mortality varied from 41·3 to 77·4 per cent., and further tests confirmed the results within 5 per cent. Variations in the resistance of different species to the same spray applied under the same conditions should always be taken into consideration in reporting tests of contact insecticides.

104. The Effect of Intensity and Duration of Light and of Duration of Darkness, Partly Modified by Temperature, upon Wing-Production in Aphids. By A. F. Shull. (*Arch. Entw. Mech. Org.*, cxv., **4-5**, Berlin, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 9, 1929, p. 490.) The experiments described were carried out in an attempt to obtain a physiological explanation of the control of wing development in Aphids.

Since almost all males are produced by wingless females and almost all gamic females by winged ones, the control of wing production in one generation controls sex in the following generation, in so far as gamic individuals are produced in the latter generation.

The percentage of winged individuals of *Macrosiphum gei*, Koch (*solanifolii*, Ashm.), produced by subjecting the wingless parents to alternate light and darkness, was again found to depend on the length of the alternating periods and the ratio of one to the other. Little effect on wing production was produced by periods of less than ten hours' darkness or two hours' light. The maximum wing-production occurred with periods of twelve to fourteen hours' darkness alternating

with five to eight hours' light. The effects of single exposures to light or darkness were relatively small and very irregular.

Temperature did not affect the production of winged Aphids below 20° C. (68° F.), but wing-production declined when the temperature was maintained above this figure, and ceased entirely at 26° C. (78·8° F.) and above.

[*Cf.* Abstract **103**, vol. v., p. 78.]

105. Principales Maladies du Coton au Kasai et au Sankuru (Congo Belge). By J. Ghesquière. (*Bull. Agr. du Congo Belge*, xix., **4**, 1928. Abstr. in *Coton et Cult. Coton.*, iv., **2**, 1929, p. 148.)

106. A Note on the Use of Dried Poison Bait against Locusts in the Sudan. By H. H. King. (*Bull. Ent. Res.*, xx., **1**, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, Pt. 9, 1929, p. 507.) Unskilled natives were found incapable of using a spraying machine effectively, or of mixing poison bran bait properly for effecting the control of locusts, and experiments, therefore, were carried out to find a bait that could be issued ready for use. One that had been sun-dried and only required moistening with water was tested during the winter of 1927-28 and during the rainy season of 1928, and reports on the results obtained were universally favourable. The stock solution is prepared by dissolving 168 lb. commercial sodium arsenite (80 per cent. As_2O_3) in water, and making the solution up to 22 gallons; to this is added 92 gallons molasses. This stock solution is diluted in the proportion of 1 part by volume to 17 parts water, so that 9 gallons dilute solution contain 1 lb. sodium arsenite. In preparing the bait, the bran is heaped on a cement floor and dilute poison added at the rate of 12 gallons to 100 lb. The bran is thoroughly stirred until it is uniformly moist; it is then spread out to dry in the sun and subsequently passed through a coarse sieve to remove any lumps. The dried bait is put up in bags each containing approximately 9¼ lb., and the bags packed eight in a sack. One gallon of water is required to moisten the contents of one bag. The bait should be stirred in until evenly moist, left for ten minutes to absorb the water and become soft, and then broadcast thinly in the path of the hoppers. The bait has been found in good condition after storing for ten months. The molasses makes it more attractive and delays its drying up.

This bait has also been used with success against the larvæ of *Agrotis ipsilon*, Hufn.

107. Preliminary Notes on the Control of Locusts (*Schistocerca gregaria*). By E. Harrison. (*Bull. Dept. Agr., Kenya*, 1929. Abstr. from *Rev. App. Ent.*, Ser. A., Pt. 8, 1929, p. 474.) It is suggested that locusts (*Schistocerca gregaria*, Forsk.) do not always invade Kenya from the outside, but they may live in the solitary form in Tanaland, the Northern Frontier Province, or in Tanganyika Territory.

Experiments showed that contact spraying with a solution of 5 to 6 oz. of sodium arsenite to 4 gallons of water was most effective, both against hoppers and the freshly-moulted adults. Dusting with sodium arsenite by means of perforated tins was also effective. Spraying the vegetation was tried with varying success, and poisoned baits also gave good results.

108. Investigations into the Locust Plague in Cyprus. By C. G. Pelaghias. (*Cyprus Agr. J.*, xxiv., Pts. 1-2, 1929. Abstr. from *Rev. App. Ent.*, xxvi., Ser. A. Pt. 10, 1929, p. 602.) The breeding areas of the locust (*Dociostaurus maroccanus*, Thnbg.) are carefully surveyed each year, and control measures are applied. These consist partly of spraying with arsenicals, but mainly of the purchase by the Government of locusts collected by means of large net-shaped bags, with which the ground is swept.

109. Instructions for the Control of the Italian and the Moroccan Locusts in Uzbekistan. (In Russian and Uzbeg.) By P. Arkhangel'skii. (Tashkent, Comissar. Agric. Uzbek. Rep., 1929. Abstr. from *Rev. App. Ent.*, Ser. A, Pt. 8, 1929, p. 478.) Instructions are given for the organization and technique of an anti-locust campaign by means of poisoned baits composed of 16 kg. cotton-seed meal, 600 gm. sodium arsenite, and 6 kg. water. Other methods, such as spraying, barriers, and burning, are recommended only as subsidiary ones.

110. Sur le Comportement de *Locusta migratoria*, L. Subsp., *Migratorioides* Rch. et Frm. Phasis *Transiens*. By B. N. Zolotarevski. (*C. R. Acad. Sci. Fr.*, clxxxix., 3, Paris, 1929. Abstr. in *Rev. App. Ent.*, xvii., Ser. A, Pt. 10, 1929, p. 570.)

111. Tsetse Fly Research. (*Ecology*, x., 3. Also *Trop. Agriculture*, vi., 9, 1929, p. 265.) A brief summary of research on tsetse fly control in Africa, by Dr. John Phillips, Deputy Director and Ecologist of the Department of Tsetse Research in Tanganyika Territory.

112. The Fusarium Disease of Cotton (Wilt) and its Control. By T. Fahmy. (*Min. of Agr. Egypt.* (*Plant Protect. Sect.*, *Mycol. Res. Div.*) *Leaflet* 11, 1929. Abstr. from *Rev. App. Mycol.*, viii., Pt. 9, 1929, p. 570.) This is a condensed popular account of the author's investigations on the *Fusarium* disease of cotton in Egypt (*F. vasinfectum*, var. *egyptiacum*).

[*Cf.* Abstracts **301**, **588**, **589**, Vol. V. of this Review.]

113. New Methods for the Diagnosis of Species of the Genus Fusarium. By G. H. Coons and M. C. Strong. (*Papers Michigan Acad. Sci. Arts and Letters*, ix., 1929. Abstr. from *Rev. App. Mycol.*, viii., 8, 1929, p. 520.) A description, accompanied by tables, is given of the results obtained in the writers' experiments in the application of a serological technique to the diagnosis of species of *Fusarium*.

114. A New Cotton Wilt. By J. J. Taubenhaus *et al.* (*Phytopath.*, xix., 2, 1929. Abstr. from *Rev. App. Mycol.*, viii., Pt. 8, 1929, p. 501.) A severe wilt disease of cotton, apparently distinct from that caused by *Fusarium vasinfectum*, has been reported from three widely separated counties of Texas, especially from Ellis County.

Affected plants are stunted and peculiarly branched, with abnormally short, stout joints; in advanced stages of the disease the plants shed their leaves and the branches become dull in colour. In some cases the plants die from the tops and new growth appears on the lower part of the main stem. Only a few of the diseased individuals are able to produce one or two bolls of cotton. Occasionally the dwarfing and stunting of infected plants is so marked as to give the impression of a rosette. The new disease may be differentiated from *Fusarium* wilt by the splitting of the stems and by the black discoloration of the interior cylinder of both roots and stems; in the typical *F. vasinfectum* wilt the latter phenomenon is mostly confined to the outer woody tissue. In the new disease the discoloration is more pronounced in the lower part of the plant, becoming progressively less higher on the stem.

Isolations from the Ellis County plants yielded a *Fusarium* apparently distinct from *F. vasinfectum*, besides species of *Alternaria*, *Sclerotinia*, *Phoma*, *Phomopsis*, and *Helminthosporium*.

The occurrence of the new wilt in the heavy black lands where root rot (*Phymatotrichum omnivorum*) is destructive is considered to be specially significant. It has recently been shown that *Fusarium* wilt is mostly confined to soils

more acid than pH 6·5 to 7·0, while root rot is destructive under more alkaline conditions. In other words, this is the first occasion on which the two types of disease, root rot and wilt, have been found in a severe form on the same soils. (*Cf.* Abstracts **301**, **588**, **589**, Vol. V. of this Review.) It is suggested that this disease is very similar to that described by Fahmy.

115. COTTON ROOT-ROT FUNGUS: VIABILITY. By G. T. Ratliffe. (*U.S. Dpt. Agr., Circ. No.* 67, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **19**, 1929, E. 28.) Observations are recorded which show that the causal organism of cotton root rot may be carried in an infectious condition in the soil over a period of several years on the roots of dead host plants, and a system of clean fallow, even when rigidly maintained for as long as three years, does not insure a satisfactory reduction of root rot where deep-seated infections occur.

116. COTTON ROOT-ROT INVESTIGATIONS IN ARIZONA. By C. J. King and H. F. Loomis. (*J. Agr. Res.*, xxxix., **3**, 1929, p. 199.) Further studies on the cotton root-rot disease at the U.S. Field Station, Sacaton, Arizona, have shown that the extension of infection into new areas can be effectively controlled by treating the soil with solutions of formaldehyde and cresylic acid.

Experiments in which organic manures were applied in furrows to alternate ¼-acre plots continuously cropped to cotton for several years, show that this treatment is effective in reducing the extent of infection, in delaying the appearance of the disease, and in retarding its injuries to the plants.

The manured plots served as effective barriers in restricting or retarding the advance of the mycelium from adjacent untreated areas.

It was indicated that under Arizona conditions the fungus was capable of passing under an open trench 20 inches deep which was dug in advance of a ring of dying alfalfa plants.

The root-rot organism is readily isolated and can be cultured successfully on various kinds of roots and other media. Its ability to grow on dead roots indicates that it may exist in nature as a saprophyte and may be able to live in the soil in the absence of live root tissues.

[*Cf.* Abstract **511**, Vol. III., p. 408.]

117. A METHOD OF INOCULATION FOR PHYMATOTRICHUM ROOT ROT-INVESTIGATIONS. By J. J. Taubenhaus *et al.* (*Phytopath.*, xix., **2**, 1929. Abstr. from *Rev. App. Mycol.*, viii., **8**, 1929, p. 502.) An outline is given of a method evolved by the writers for the inoculation of cotton and other plants with the causal organism of root rot (*Phymatotrichum omnivorum*). Recently wilted cotton or other plants are pulled by hand, the tops cut off at ground level, and the roots (usually covered with a copious surface growth of the fungus) dropped into moist sacks, kept moist, and used as rapidly as possible for inoculum. Under field conditions a crowbar is used to pierce a hole in the soil 1 to 1½ inches from the stem of the plant to be inoculated. One or more of the fresh pieces of inoculum are placed in the hole one or two inches below the surface, and the soil pressed together again. Particularly successful results have been obtained in soils with a high moisture content. Out of 840 cotton plants at College Station, Texas, inoculated by this method in the early summer of 1928, 41 per cent. wilted within the next twenty-four days, and almost every plant was killed by root rot within the following three weeks, while there was still under 1 per cent. of the disease in the adjacent control rows.

[*Cf.* Abstract **44**.]

118. ASPERGILLUS FUNGI: PHYSIOLOGY. By W. Schwartz. (*Bot. Centr.*, **14**, 1929. From *Flora*, **23**, 1928. Abstr. from *J. of Text. Inst.*, xx., **9**, 1929, A. 513.) A study of the conditions of perithecium and sclerotium formation by different types of Aspergillus.

GENERAL BOTANY, BREEDING, ETC.

119. Studies in Cotton Pollen. By I. Banerji. (*Agr. J. Ind.*, xxiv., 5, 1929, p. 332.) The investigations had to be confined to the pure-line cultures available at the Coimbatore station, viz., *Gossypium hirsutum*, Mill. (Cambodia); *G. barbadense*, L. (Ratto Sea Island); *G. indicum*, L. (Nandyal 14); *G. herbaceum*, L. (Hagari 25); *G. cernuum*, Todaro; *G. neglectum*, Todaro, var. *roseum*.

The results of the investigations are summarized as follows:

(1) Cotton pollen is characteristically spherical in shape; it has numerous points of emergence. The mean diameter of the Indian cottons studied, measured from spine to spine, is between 116·60 and 125·95 microns.

(2) Comparative differences in the size, shape, and sculpturings of the exine were noted in all the cottons studied. Two forms of pollen grains characteristically different and occurring in the same andrœcium were noted in some cases in *herbaceum* cottons (Hagari 25).

(3) From the evidence at hand it appears that artificial cotton pollen germination depends upon delicate moisture requirements. Pollen grains retain their viability under natural conditions up to the twenty-fourth hour after their liberation from the microsporangium, and lose their potency within the next twenty-four hours.

(4) The more active pollen tubes were found to have traversed the entire stylar length (mean 24·7 mm. for Cambodia cotton) within twelve hours after pollination.

(5) The inheritance of pollen colour in a natural cross of Sea Island cotton studied is dependent on a single Mendelian factor.

120. The Natural Crossing of Cotton Flowers in Egypt. By Dr. W. L. Balls. (*Tech. and Sci. Serv. Bull. No.* 89, 1929, Govt. Press, Cairo. Price: P.T.5.) Webber in America, and Balls in Egypt, first recognized the existence of crossing in cotton flowers, and put it down at about 5 per cent. It is clear that when different stocks are grown side by side, this must have a great and cumulative effect, and be largely responsible for what is usually called the deterioration of stocks so often complained about. Two empirical methods of checking it were put into practice in Egypt in 1912—caging, or enclosing the plants in fine wire gauze; and belting, or leaving a belt 10 metres wide in which crossing by bees might go on and leave the central part uncontaminated.

Some of the complications that beset experimental work on this subject are pointed out—for example, the possible greater potency of the plant's own, or of foreign, pollen, the difficulties introduced by having the source of pollen at the centre of a mass, or at one end without a T-shaped overlap, and so on.

From experiments carried out in Egypt, it is inferred that the average amount of natural crossing at 10 metres distance is of the order of 0·6 per cent., and that it is halved for every doubling of the distance. Up to 50 metres there is appreciable crossing, and a belt of 10 metres is quite inadequate. Experiments by H. B. Brown in the United States are quoted, which give somewhat similar results, and suggest that reasonable safety is not attained under 100 metres.

The paper then goes on to consider the distribution of vicinism in time, starting from an observation by Mr. C. H. Brown that there were no bees in the cotton fields in late July. It is shown that vicinism diminishes very greatly from June with 0·40 per cent. to August with 0·06 per cent., and this indicates that the late season is best for picking for purity of crop.

The various pollen-carrying insects are then considered in detail.

121. Bud Mutation in Cotton. (*Trop. Agriculture*, vi., 10, 1929, p. 275.) A form of *Gossypium arboreum* (Linn.) known as Burma Laciniated, with extremely deeply laciniated leaves, has been grown for several generations at the

Cotton Research Station. The original plant appeared in a mixed lot of Asiatic cottons grown from seed brought by Dr. S. C. Harland from Mahlaing, Burma. A graft from a plant of the second generation grown in Trinidad was planted in the greenhouse. Selfed seed from this graft was planted, and bred true in all obvious characters.

In June, 1929, the grafted plant gave rise to a branch which has broad leaves. The leaf index (length of leaf ÷ length to sinus) of typical leaves is about 10 to 13. The leaf index of leaves on the mutant branch is about 2·0 to 2·2.

This mutation has crossed at one step the boundary between *G. arboreum* and *G. Nanking* (see Watt*), which Leake† has shown is due to a difference in a single gene. Since the arboreum (laciniated) type of leaf is dominant to the Nanking type in Trinidad, and since Burma Laciniated has been shown to breed true, it follows that the same mutation occurred in both homologous chromosomes. It would be of great interest to discover whether the two mutations occurred simultaneously or whether one followed the other. The first two leaves on the mutant branch are laciniated. The branch was cut off above the third leaf, and grafted on to a perennial stock. A shoot appeared at each of the three nodes, and an extra shoot appeared from a bud on the parent branch at the base of the mutant branch. This latter bore laciniated leaves. The shoots from all three nodes on the mutant branch had broad leaves. Clearly both mutations occurred below the first node on the mutant branch, and were either simultaneous or followed one another during the formation of a single node, which is only 2 mm. long.—J. B. H.

122. Cotton-Breeding Studies: I. Inheritance of Fibre Length. II. Heritable Relationship of Red Plant Colour and Leaf Shape. By J. O. Ware. (*Bull. No.* 243, Agr. Exp. Sta., Arkansas, 1929.)

I. *Inheritance of Fibre Length.*—Long fibre is dominant over short fibre in the three sets of crosses. Dominance is practically complete in the A and C crosses, while length of fibre is somewhat intensified in the B crosses. However, when the means of the corresponding populations of the three sets of crosses are averaged, the F_1 length is not significantly different from that of the long lint parental strain.

II. *Heritable Relationship of Red Plant Colour and Leaf Shape.*—Red cotton plants when crossed with green cotton plants produce uniformly dilute red plants in the F_1 generation. These first generation plants, when selfed and grown as the F_2 generation, break up into three colour classes: red plants, dilute red plants, and green plants. The ratio is approximately a 1:2:1. The red plant number is usually slightly below one-fourth of the total population, and the green plant number somewhat above one-fourth. The dilute red group usually embraces slightly more than one-half of the total plants.

[*Cf.* Abstr. 2.]

FIBRE, YARN, SPINNING, WEAVING, ETC.

123. Cotton Fibre Studies. By R. C. Campbell. (*Bull. No.* 158, Exp. Sta., Ga., 1929.) *Summary.*—From Tables 1, 3, 8, and 9 it is noted that the breaking or tensile strength per hair for the varieties tested shows that as the weight per inch of a cotton-seed hair increases, the tensile strength increases. Generally speaking, mature and well-developed cotton-seed hairs are stronger than immature thin-walled ones. This seems to justify a common accusation that the

---

* Watt, Sir G., "The Wild and Cultivated Cotton Plants of the World" (Longmans, Green and Co., 1907).

† Leake, H. M., "Studies in Indian Cotton" (*Jour. Gen.*, vol. i., No. 3, 1911).

presence of a medium to high percentage of immature hairs in a sample of lint will weaken the tensile strength of the fibre, and to some extent the tensile strength of the yarn. The strength of the yarn, however, will probably be affected very little, if any, by the presence of immature hairs, since the same size of yarn would contain more hairs per cross-section with a higher percentage of immature hairs.

The weight of cotton-seed hair per unit length increases with the processes of maturity from the date of fertilization to the date that the bolls open. Increase during the first four weeks is due almost entirely to elongation of cells. During the remainder of the maturation period the increase is due almost entirely to secondary thickening of the cell wall. These observations and others of like nature show that about two-thirds of the weight of ripe cotton-seed hairs is due to secondary thickening of the wall of the hair cells.

Judging from various studies and observations in this laboratory, the cotton-seed hair elongates very little, if any, after about the thirtieth to thirty-second day of maturation. The maximum length is reached sometime about the thirtieth day for varieties the bolls of which mature in about forty-seven to fifty days after the blossom opens. Varieties that have a maturation period of fifty-four to fifty-eight days require a proportionately longer period for hair elongation.

As a general rule, short seed hairs are heavier in proportion to their length than long ones. This indicates that ordinarily long staple cottons have a finer lint than short staple, although there are exceptions.

124. METHODES DE MENSURATIONS DES FIBRES DE COTON. By W. Mees. (*Agr. et Elévage au Congo Belge*, Brussels, 1928. Abstr. from *Int. Rev. of Agr.*, xx., **5**, 1929, p. 191.) The author in this copiously illustrated article describes the two principal methods of combing raw cotton known as the "halo" and "butterfly" methods. He also describes the methods of measuring the divided fibres, either by a special indicator or by a calliper, and the method of measuring as applied to ginned cotton, which is known in America as "pulling."

125. THE DETERMINATION OF HUMIDITY IN EGYPTIAN COTTON IN ITALY. By Prof. C. Levi. (*Int. Cot. Bull.*, viii., **29**, 1929, p. 148.)

126. MOISTURE IN EGYPTIAN COTTON. (*Int. Cot. Bull.*, viii., **29**, 1929, p. 136.)

127. FIBRE MICROSCOPY ACCESSORIES. By A. Herzog. (*Kunstseide*, 1929, xi., 334/8 and 381/6. Abstr. from *Summ. of Curr. Lit.*, ix., **20**, 1929, L. 22.) The author describes various simple devices for use in the microscopical and chemical analysis of fibrous materials. These devices include blocks for the quick preparation of cross-sections, squared and ruled glasses, and planimeter-harps for determining fineness and cross-section areas, special rulers, microscope stages, weighing glasses, marking devices, devices for measuring the thickness of cover glasses, stages, paper, and fabrics, and vessels for the preparation of cuprammonium solutions and for the maceration and filtration of fibrous materials.

128. "ARTIFICIAL COTTON": STRUCTURE AND PROPERTIES. (*Text. Merc.*, **80**, 1929. Abstr. from *J. of Text. Inst.*, xx., **10**, 1929, A. 518.) Photo-micrographs of artificial cotton show that this fibre has the chief characteristics of bast fibres. The individual cells are of a spindle shape, with a cell length varying in great degree. A maximum fibre length of 1½ inches and a minimum of ⅛ inch have been observed. Over a large number of specimens it is probable that the average length of fibre would be approximately ⅝ inch. The fibres possess a well-marked lumen or intercellular cavity, and are all attenuated towards each end, and as the lumen approaches the apices it gradually disappears until the cell apices are apparently solid cellulose. The laminated structure of the fibres, as viewed in cross-section under very high magnification after special treatment, suggested that there was a very intricate fibrillar structure similar to cotton. The cross-

sections vary in diameter from 18 to 35 μ. The sectional diameter varies greatly when taken throughout the whole length. The average breaking strain is 102 grains, which is about 23 per cent. weaker than the average cotton hair, and 49 per cent. weaker than the East Indian variety of cotton, which this fibre mostly resembles. Comparisons are given. The fibre does not possess any of the qualities required for successful manufacturing and finishing.

129. Maintaining the Strength of Cotton Yarns. By W. H. B. (*Text. Rec.*, xlvii., **558**, 1929, p. 30.) Explains the methods adopted in an American mill to make cotton yarn of the desired breaking strength consistently.

130. Cotton Yarns: Variation in Tension during Spinning. (Natl. Assoc. Cotton Mnfrs., *Bull. No.* 111, 1929. From Report issued by the Lowell Textile Institute. Abstr. from *Summ. of Curr. Lit.*, ix., **15**, 1929, G. 28.) Tests have been made of the variation in tension of a 17's cotton yarn during spinning. The variation in tension which occurs in a single traverse is due to the centrifugal force of the increasing material in the balloon strand as the rail descends, and to small inequalities in the roving. There is less variation in tension during one traverse of weft wind than during one traverse of warp wind. The weft wind yields a lower and more uniform tension than the warp wind. The tension during the up traverse very closely parallels that of the down traverse, although the data seem to indicate a tendency for the former to exceed the latter slightly. In the case of the warp wind, the tension at the bottom of the traverse always exceeds that at the top, averaging for the entire bobbin 45 per cent. excess over the latter. Top and bottom tensions remain fairly uniform during the entire build of the package. In the case of the weft wind the tension at the bottom of traverses as the bobbin is filled decreases at a regularly decreasing rate. The tension at the top of traverses for the first half of the package is less, and for the second half considerably greater than at the bottom. The tension increases with increase in traveller weight. In weft wind, the round point gives a smaller tension, while the reverse is true in warp wind. Increasing strength of yarn appears to accompany increasing tension.

131. Loose Cotton: Effect on Yarn-breaking Strength. Texas Textile Association. (*Cotton*, **93**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **16**, 1929, G. 30.) Loose cotton requires careful scutching, and in some cases has been found to increase the number of fires in the scutcher room. Certain percentages of loose cotton have been run successfully, but tests show that loose cotton reduces the breaking strength of the yarn, the reduction in strength increasing with the amount of loose cotton used. In one mill 10 per cent. loose cotton has been used without any bad effects after the installation of better opening equipment. The breaking strength, however, went down about two pounds on 9's.

132. Yarn of Standard Breaking Strength: Production. (*Text. World* [U.S.], **76**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **16**, 1929, G. 31.) The foundation for standard breaking strength lies in the selection of the cotton and in the conditioning of it before sending to the blow room. Excessive twist to a certain extent will add strength but reduce production. Substituting long cotton for short will add greatly to the cost per pound, and reduce the margin of profit. Decreasing the draft on drawing, roving, and spinning frames will reduce the productive power of the machines and add labour and power costs. In order to obtain the strength desired care should be taken to avoid excessive beats per inch in the blow room, and particular attention should be given to the lapping of the cards, the putting in of new ends on the drawing frames, the tension between the front roller and calender, the lay and tension of the roving, and the cleaning of bolster necks and rollers in the spinning room. Directions and formulæ are given for determining the correct number of beats, beater, licker-in, and doffer settings,

the right trumpet bore for a given weight sliver, and the gear for a new hank roving. The adjustment of the twist in the roving and yarns, according to moisture content, is illustrated.

133. THE REMARKABLE INSTABILITY OF WEIGHT SHOWN BY BALES OF COTTON. By Dr. W. L. Balls. (*Int. Cot. Bull.*, viii., **29**, 1929, p. 127.)

134. COTTON: OPENING AND CLEANING. By T. Hagan. (*Trans. Nat. Asscn, Cotton Manufrs., U.S.A.*, 1928, No. 124. Abstr. in *Summ. of Curr. Lit.*, ix., **20**, 1929, F. 16.)

135. OPENING AND CLEANING MACHINE. Hill and Cutler, Ltd., New Bedford, U.S.A. E.P. 310,926 of May 3, 1928. (*J. of Text. Inst.*, xx., **9**, 1929, A. 484.) A machine for removing foreign matter from cotton waste or other fibrous materials comprises a feed belt leading to a series of rotating cages with quickly rotating intermediate fluted rollers. The cages preferably taper from the centre to the end, and the series is inclined upwards towards the delivery end. The second cage rotates more slowly than the first, and then the speeds progressively increase. The material is delivered on to a belt and passed to a pair of cage rollers which deliver it over a comb to a hopper from which it may be removed by suction. Foreign matter falls from the material into the cages and out through the bottoms of them. The rollers carrying the belts may be magnetized to remove pieces of metal from the material, and the adjacent cages be made of brass.

136. AUTOMATIC LOOMS. (*Int. Cot. Bull.*, viii., **29**, 1929, p. 167.) Analyses of returns received in reply to a questionnaire sent by the International Cotton Federation to various countries where automatic looms were being used. The question as to the use of automatic looms is dealt with from the English viewpoint by Mr. Thomas Ashurst, and from the Continental point of view by Mr. Caspar Jenny.

137. AUTOMATIC LOOM: USE IN JAPAN. By A. S. Pearse. (*Text. Merc.*, **81**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **18**, 1929, I. 47.) About 20,000 looms are now working in Japan on some kind of automatic principle, including Northrop and Stafford looms, and the Toyoda and other looms of Japanese invention. Their introduction has placed the weaving industry in a favourable position.

138. SPINNING AND WEAVING COSTS IN JAPAN. By F. Utley. (*Man. Guar. Coml.*, **19**, 1929. Abstr. from *Summ. of Curr. Lit.*, ix., **16**, 1929, M. 14.) A reply to criticisms of a previous article. The writer maintains that her figures were not based on isolated cases from observations in only a few mills, and that weavers in Japan commonly work four to six looms (with warp stop motion), and that some can attend as many as eight or nine on coarse materials.

[*Cf.* Abstracts **553, 554, 555, 556**, Vol. VI., p. 357.)

139. COTTON GOODS: PRODUCTION COSTS IN JAPAN. (*Man. Guar. Coml.*, **18**, 1929, 619. Abstr. from *J. of Text. Inst.*, xx., **9**, 1929, A. 516.) The author, who claims to be an "insider" as opposed to a visiting observer, contends that, in spite of recent reversal of opinion, much of Japan's advantage in cotton production is due to low wages rather than to the superior buying and marketing to which it has more recently been ascribed. The opinion is expressed that the skill and organizing capacity of which Lancashire is capable are sufficient to counterbalance the advantage of low wages if they are fully exercised.

140. JAPAN: THE ABOLITION OF MIDNIGHT WORKING IN COTTON SPINNING. (*Monthly Circ.*, August, 1929, of the Econ. Res. Dpt. of Messrs. Mitsubishi Goshi Kaisha, Tokyo.) The new law prohibiting midnight work (10 p.m. to 5 a.m.) of women and children came into effect on July 1. No less than 80 per cent. of

the workers are women, and the result equals a reduction of 15 per cent. in manufacturing capacity. To meet the new conditions the mills have increased the number of spindles. The number of spindles per woman worker has increased from 34·79 to 44·66. It is anticipated that with the abolition of voluntary curtailment, and increased efficiency, the production of yarn may show a considerable increase.

[*Cf.* Abstract 40.]

LEGISLATION.

141. TANGANYIKA TERRITORY. *Government Notice No.* 140 *of July* 11, 1929 (cited as *Cotton Fees Rules*, 1929), requires that the fees set forth in the Schedule to the Cotton (Fees) Rules, 1927, shall be payable for the year ending March 31, 1930.

Government Notice No. 142 *of July* 19, 1929 (cited as *Cotton Cess Rules*, 1929), provides for the payment of fees to the District Officer by purchasers of native cotton in Mwanza Province, and the Lindi, Mikindani, Masasi, and Tunduru Districts of the Territory.

Government Notice No. 146 *of August* 7, 1929 (cited as *Cotton Fees Rules* (*No.* 2), 1929), revokes Cotton Fees Rules, 1929, and states the revised fees payable for the year ending March 31, 1930.

[*Cf.* Abstr. 31.]

TRADE, CO-OPERATION.

142. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1929-30. (London, Manchester, Bradford, New York, Montreal. 30s. net.) This is the seventh issue of this all-embracing directory of the cotton trade. The thumb-holes, by whose aid easy reference is made to the various sections, are labelled: Contents (given in six different languages), Advertisers, Exporters, Merchants and Brokers, Waste Merchants, Spinners and Manufacturers—Great Britain, including a list of Directors, etc., United States, Germany, France, Italy, India, China, Japan, Other Countries—Yarns, Piece Goods, Fabrics, Artificial Silk, Mill Supplies, Textile Machinery, Electrical, Chemicals. All the information under each head is given in the most careful detail, with titles of firms, addresses, capital, number of spindles, etc. Since the previous edition was published, substantial efforts have been made to augment still further the information contained in the volume; many new names have been added, and valuable additions have also been made to the particulars previously published. The book is as indispensable as ever to all those engaged in the cotton trade.

143. ARGENTINE. COTTON EXPORTS. (*Rpt. of Cent. Argentine Rly.*, June, 1929.) The exports of cotton during 1928 amounted to 11,980 metric tons (equal to 66,040 bales of 400 lb.), valued at £713,982, as compared with 7,220 metric tons (39,800 bales of 400 lb.), valued at £392,749 in 1927.

144. BELGIUM. COTTON EXPORTS. (*Man. Guar. Coml.*, xix., 1929. Abstr. from *Summ. of Curr. Lit.*, ix., 16, 1929. M. 14.) Belgian exports of cotton piece-goods have increased from 31,456,000 kilograms in 1925 to 43,672,000 last year. The increase in exports has, however, only been achieved at the expense of reduced profit margins. In addition, foreign buyers are now asking for longer credits, and a large number of manufacturers have to miss business on that account.

145. LANCASHIRE COTTON FAIR. The first great Lancashire Cotton Fair is to be opened in Manchester on February 11, 1930. It is sponsored by the *Daily Dispatch*, and supported by the various cotton-trade organizations (whether of manufacturers or of operatives), and is intended to call greater attention to what

Lancashire can do in the cotton industry. A strong Committee has been appointed, and every effort is being made to produce a really successful event.

146. LANCASHIRE COTTON CORPORATION, LIMITED. (*Text. Rec.*, xlvii., **559**, 1929, p. 44.) The Lancashire Cotton Corporation is now supervising forty-eight cotton spinning and weaving companies, with a view to their ultimate absorption, these companies between them controlling more than 4½ million spindles and 6,000 looms. It is expected that some 60 to 100 mills controlling at least 10,000,000 spindles and 20,000 looms will ultimately be absorbed.

147. COTTON FOR PROPELLERS. (*Text. Rec.*, xlvii., **559**, 1929, p. 106.) According to a report of the U.S. Dept. of Commerce, one of the newer uses for cotton is in the making of airplane propellers. The cotton fabric is impregnated with a synthetic resinous material, and numerous layers are put together under tremendous pressure to form slabs, from which the propellers are fashioned in much the same manner as from wood.

148. COTTON SOLD CO-OPERATIVELY. (*Text. Rec.*, xlvii., **559**, 1929, p. 102.) Approximately 8 per cent. of the 1928 cotton crop was marketed through sixteen co-operative associations, according to the U.S. Dept. of Agriculture. This is a larger percentage than for either of the two preceding seasons, but not as large a percentage as that for 1925, when 9·1 per cent. of the crop was marketed by fifteen associations.

[*Cf.* Abstracts **7, 34, 38.**]

MISCELLANEOUS.

149. THE INTERNATIONAL COTTON CONGRESS, 1929. (*Text. Rec.*, xlvii., **559**, 1929, p. 27.) The Fourteenth International Cotton Congress, held at Barcelona in September, was officially opened by Count de los Andes in the presence of 260 delegates from nineteen countries.

Responding to the official welcome, Mr. F. Holroyd, president of the International Federation, spoke of the activities of the Federation during its life of twenty-five years. He also commented on the present unsatisfactory position of the cotton industry in England.

Mr. William Howarth, managing director of the Fine Cotton Spinners' and Doublers' Association, reviewed the work of cotton-growing in the British Empire. Britain, he said, took the lead in this work. They had spent much time and money upon it, and had placed their experience freely at the service of the world's trade. The total amount of cotton with a staple of $1\frac{1}{16}$ inches and over produced in new fields in the British Empire, including parts of India, is roughly 1,000,000 bales. This work has encouraged other countries to follow suit. It has also effected almost revolutionary improvements in cotton-growing research. Many new types of cotton have been propagated, and numerous enemies of the plant are being satisfactorily dealt with.

On the last day of the Congress Mr. Thomas Ashurst introduced a discussion on automatic looms, which proved to be most interesting.

[A number of interesting papers were read, and will be found in the *Int. Cot. Bull.*, viii., **29**, November, 1929. The titles of many are given in our present number.]

150. THE INTERNATIONAL YEAR BOOK OF AGRICULTURAL STATISTICS. The International Institute of Agriculture at Rome has just recently published the 1929 edition of the International Year Book of Agricultural Statistics. This volume of about 600 pages gives the area and population—pre-war and post-war—for 220 countries, and a vast amount of statistics for the different crops.

151. TROPICAL AGRICULTURAL RESEARCH. By H. Martin Leake. (*Empire Prod. and Export*, 1929. Abstr. from *Trop. Agriculturist*, lxxiii., **1**, 1929, p. **21.**)

Deals with the subject under the following heads: Organization of research; the industrial analogy; present position of research; wider yet closer control; past the pioneer stage; rationalization; attracting and use of personnel; contrasts with industrial system; research in the sugar industry; Government services; sentimental difficulties; importance of statistical records; accountancy essential: true use of Government research; variety of ownership system; the main problem.

152. JAPAN. *Cotton Research Laboratory.* (*Coton et Cult. Coton.*, iv., 2, 1929, p. 190.) A vote of 1,900,000 yen has been passed to establish a cotton research laboratory at Osaka or Nagoya. Japan now holds third place among buyers of American cotton, the value of her purchases in 1928 being 129 million dollars.

153. FROM COTTON FIELDS TO FINISHED PRODUCT. (*Text. Merc.*, August 16 and September 27, 1929.) These articles continue the series mentioned in Abstract 657, Vol. VI., p. 379 of this Review. The first deals with cotton-growing in Northern Rhodesia, Sudan, Uganda, Tanganyika, and Nyasaland; the second, with spinning tests and fibre comparisons.

154. THE SEVEN WONDERS OF SOUTHERN AFRICA. By Hedley A. Chilvers. (Pubd. by authority of the S. Afr. Rlys. and Harbours, Johannesburg, 1929.) Perhaps the most readable general account of South Africa that we have yet encountered, and one which does justice to the work of the great pioneers—Portuguese, Dutch, and English.

The volume contains a series of interesting chapters on the historical, economic, ethnological, and physical interests of Southern Africa, together with chapters bearing upon Rhodesia and the Eastern African Dependencies.

155. TROPICAL HYGIENE. The Fifth Annual Report of the London School of Hygiene and Tropical Medicine (University of London) was presented by Lord Melchett, the Chairman, at the Annual Meeting of the Court of Governors, held on November 27. Special reference is made in the report to the new course of study designed to prepare candidates for the examination for the Diplomas in Public Health, and especially the new academic Diploma instituted this year by the University of London. This course is planned in a broad, practical spirit, and gives promise of a great advance on anything which has hitherto been systematically attempted with regard to public health teaching. Two large centres of public health administration have been secured as demonstration areas, an advisory committee of experts of the first standing in the Public Health Service appointed, and a scheme of special lectures arranged to be given by men and women eminent in their subjects; the course also provides for visits to works, factories, slum areas, garden cities, schools, and other institutions.

PUBLICATIONS RECEIVED

We have to acknowledge the receipt of the following publications for the Library.

From the Edinburgh and East of Scotland College of Agriculture.

FENTON, E. WYLLIE: *Seeds Mixtures and the Incidence of Fungal Disease.*
OGG, W. G.: *Soil Classification and Soil Surveys.*

PERSONAL NOTES

We much regret to announce the death of Mr. G. B. Zochonis, which occurred on December 2, at Mountlands, Bowdon, Cheshire. Mr. Zochonis was a member of the Council of the Corporation.

We also regret to announce the death of Professor T. B. Wood, which occurred on November 6, at Saxlingham, Holt, Norfolk. Professor Wood was a member of the Research and Studentship Selection Committees of the Corporation.

We regret to learn of the retirement of Sir John Farmer from the post of Professor of Botany at the Imperial College of Science and Technology; it is gratifying to know, however, that the Corporation will still have the benefit of his valued assistance on the Research and Studentship Selection Committees.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Ceylon	Dr. J. C. Hutson.
Fiji	Mr. J. G. C. Campbell.
Gold Coast	Mr. A. Z. Culham.
,,	Mr. G. H. Eady.
Kenya Colony	Mr. R. C. Bentall.
,, ,,	Mr. D. L. Blunt.
Nigeria	Mr. L. J. Jackson.
Nyasaland	Mr. F. Barker.
,,	Mr. A. S. W. Hornby.
,,	Mr. E. J. Wortley.
Sierra Leone	Captain F. W. Browning Allinson.
,,	Mr. D. C. Edwards.
Tanganyika	Mr. W. V. Harris.
,,	Mr. D. Sturdy.
,,	Mr. K. E. Toms.
Uganda	Mr. N. S. Haig.
,,	Mr. G. T. Philpott.

Dr. T. G. Mason, Head of the Physiological Department, Cotton Research Station, Trinidad, is also on leave in this country.

Printed in Great Britain by Billing and Sons Ltd. Guildford and Esher

THE
EMPIRE COTTON GROWING
REVIEW

VOL. VII. APRIL, 1930. NO. 2

HARVESTING THE RESULTS OF RESEARCH

AGRICULTURAL progress depends to a great and always increasing extent upon the results of research—that is to say. upon the results of careful, thorough, and unbiassed investigation into the various principles, conditions, and other matters that determine the actual field practices and methods. Such researches may deal with many subjects, as, for example, with the breeding of improved varieties or races that will give greater yield or better quality, or both; with the improvement of tools, of cultivation, of manuring, of harvesting, of preparation of the produce for market, of its transport to market, of its sale there, and so on. In fact, a research may deal with any of the multitudinous factors that have some share in the final result. Any research that will show the cultivator how to produce greater money value than before, without involving greater increase in work or expenditure than is justifiable by that greater monetary return, is of value, and its results should be made public as soon and as widely as may be. (Incidentally, it affords another illustration of how all agricultural work hinges upon finance, which must never be lost sight of.)

Most results that actually occur in practice depend, however, not upon one factor only, but upon many, and to carry a research to a successful conclusion depends often to a very large extent upon the capacity of the researcher to eliminate the action of all but one of these factors, and therefore to determine what is the action of that one, and whether any modification in that action is likely to produce any benefit. Now for such work there is needed a worker with a particular type of mind, and he must be *trained* in carrying out the kind of work required. But when a subject is made the basis of training, there must inevitably spring up a technical way of looking at it. Certain phenomena recur over and over again, and for these,

to save enormous circumlocution, technical terms must be used, and in every branch of work such terms become frequent. To the spinner such terms as draft, count, weft, and so on become part of his ordinary everyday language, and equally so to the breeder are such terms as selfed, pure line, F_1, and the like, while the grower, the ginner, the broker, and others also have their terms. But to the worker in one of these lines the terms used by another may not be at all familiar.

Having carried out his research to the point where he has made up his mind as to certain definite conclusions, the worker has next to submit it to the chief of his department, and it is upon the action taken by the latter that the value of the research largely depends, for it is through him that the results are to be brought home to the people who are to profit by them. The question is, what action shall he take (of course, first satisfying himself that the results are sound, and to be depended upon)?

Before dealing with the bringing home of the results to the agricultural public to whom the department belongs, there is one aspect of the research work that must be considered. Any piece of sound work is of interest, not only in the place where it is carried out, but also to workers in other places, to whom it may save much time and labour that would otherwise have to be spent in what, after all, are but repetitions. But to make the results thus useful, full details must be published, and these are of little interest to the "constituency" of practical agriculturists who support and pay for the researches done. If the matter is of fairly wide general interest, one of the scientific or technical journals will usually be ready to take the paper describing it. But in cases where it is not thus acceptable, the chief will have to arrange some other method of publication, whether in his annual report or elsewhere. If he do not consider the details to be worth this cost, he must cut down the paper to make it suitable to she next category that has to be considered below.

The real matter to be dealt with in this article is, how are the results of research to be brought home to the agricultural public—primarily, of course, that to which the department belongs, and which pays the cost of it—as rapidly, as widely, as accurately, and as cheaply as is possible? Here again the judgment of the chief is called into play, and it is he who must decide whether to act by simple publication, by lectures, by field demonstration, by more than one of these, or in other ways.

Supposing that he decides that publication only will be sufficient, he is likely to be faced immediately with the difficulty that a large

(probably a *very* large) majority of his constituency will be unable to understand English. They may even speak two or more different languages. Further, they may very likely be folk of but slight education, who will not be able to understand anything that is not couched in the very simplest possible language. The chief will have to decide in what languages to publish, and will probably have to do some editing before the article will be clearly and easily intelligible to his readers. It is not given to every research worker to express himself clearly in writing or in speech, and as already explained, he is usually so steeped in a more or less technical language that he is apt to use it more than is absolutely necessary. Even if he avoid an excessive use of the terms themselves, his expression is apt to be of the technical and abbreviated kind, which in general is not easy of understanding by the man who does not himself work in that line, though he may be equally intelligent. In general, it is hardly too much to say that many research and technical workers are apt not to be well endowed with the faculty of clear and lucid expression, whether in speaking or in writing. The question then arises, whether the chief can himself supply the needful clarity, or whether it is worth while to have a special liaison officer who can. A research paper, not infrequently, may need almost complete rewriting in simpler language to be properly understood and acted upon by the general agricultural public.

To promote understanding of any new work by means of lectures, given by the author, is often more effective than publication in print, for the audience can ask questions until they have received answers that will satisfy them about the matter lectured upon. In the few cases where the amount of work is sufficient to make a special liaison officer worth while, he should always be chosen in part for his capacity to give good and clear lectures, and in the vernacular when required.

But it will very commonly happen that mere publication, whether in print or by lecturing (including vernacular), will not be enough, and that some practical demonstration of the proposed novelty is required. This is a matter that requires very careful consideration, though again, of course, it falls to the chief to decide exactly what is needful, and to see that it is done.

There are a number of ways in which demonstration may be given, and the best must be chosen for each particular case. One may have:

(*a*) A demonstration plot or farm at headquarters (or elsewhere), or the same with branch farms, and one or all may be permanent or temporary.

(*b*) Demonstration plots in school gardens or other public or semi-public land—

(1) Worked by departmental labour and supervision; or
(2) Worked by school or other labour under more or less departmental supervision.

(*c*) A demonstration farm or farms (plot or plots) upon land not belonging to the department or to the Government; worked, as last, by departmental or by outside labour.

(*d*) Peripatetic demonstration plots—*i.e.*, plots opened at one place for the purpose of demonstrating some improved crop or method, and after a season or two moved to some other place; these will usually be upon land rented or otherwise obtained for the purpose, and will be worked as the last by departmental or other labour and supervision.

(*e*) Peripatetic demonstrations (suitable only for such things as ginning, cleaning, preparation for market and the like) in railway or motor vans, or by other methods, and worked by departmental labour and supervision.

There is much to be said for a permanent demonstration at head-quarters, for it can be efficiently managed at the least expense, and has libraries, laboratories and the general staff of the department close at hand. The objection is that this one station is usually not enough, inasmuch as people cannot afford the time or the money to visit it if they happen to live at any serious distance away. This difficulty can, to some extent, be got over by opening two or three or more stations at carefully selected localities in different parts of the country.

For a number of things, where large areas are not required, school gardens or other public or semi-public areas may sometimes be made use of, and if the work does not require special skill or training, it may be done by the boys at small cost.

Another method that has been employed with success in America and elsewhere is to engage a piece of land in private ownership, and either to give the demonstration upon it with departmental labour, or to get the owner or occupier of the land to do the work himself under any needful departmental supervision, guaranteeing him against any loss that there may be, but allowing him to keep any profit. For work of this kind to be useful, extra care should be taken, before it is commenced, to be sure that the improvement is certain (so far as can reasonably be determined).

For a number of lines of work, such an arrangement may with advantage be peripatetic, the staff moving on to a new place after a time.

For many things, an actual peripatetic demonstration may be housed in some vehicle, and taken from place to place for exhibition. This method enables a great number of places to be visited, but is, of course, unsuited to such subjects as improvements in cultivation and the like.

In conclusion, it scarcely needs to be pointed out that any two or more of these various methods may be combined—*e.g.*, that a demonstration plot may be aided by lectures. For the purpose of staffing any work of this kind, men with a different turn of mind from the actual research workers are needed, men with thorough field agricultural capacity, but also capable of teaching by lecture and otherwise in a clear and agreeable manner.

The officer in charge of the work, be it publication, lecturing, or demonstration, will in many or most cases have to be really fluent in the vernacular, which usually means that his activities will have to be confined to a certain more or less limited range. An officer speaking Hindustani will be of no special value in South India or Ceylon, to take a single instance. He must therefore have sufficient opportunity of promotion—in salary, if in nothing else—available within the range of the language that he speaks.

This same officer, again, will have to be selected from the type of man to whom originality does not appeal, for he will not himself have to do original research, but only to expound the result of research done by someone else. He must be a tactful person who can get on well with the people, if he have to do anything more than edit for the press.

Demonstration plots must be convenient of access, but the question of soils and climates must never be left out of sight, and they must not be placed in sites where these features are not fairly representative. Further, if soil or climate differ very much from those in which the results to be demonstrated were originally worked out, there will be considerable risk that results do not agree with the original results, and in demonstration work, especially with comparatively ignorant people, it is very important to be very sure of results before one begins—failure is very damaging to prestige, which is the European's greatest asset in the tropics.

If the demonstration be given upon private land, with work done by the owner, it is important to select only subjects that one knows that the owner can successfully understand and carry out, and regular inspection and encouragement must be given to the work.

To sum it all up, the bringing home to the people of the results

of research will depend mainly upon the action taken by the chief of the department concerned. If he is so fortunate, as was the writer, as to have good research workers who can also make things clear in publications, in lectures, and in the field, then his task is an easy one, but if, as may well happen, this is not so, he must then decide (and of course financial considerations will have much weight in the matter) how he will act, whether by simple publication (including vernacular), by lectures, or by field demonstrations, or by combination of two or more of these, since it is as a rule upon the action taken by him that the possibility of success will chiefly depend.

COTTON IN SIERRA LEONE

AN ATTEMPT TO IMPROVE THE NATIVE TYPE.

BY

D. C. EDWARDS, B.Sc.,

Late Agricultural Department, Sierra Leone.

THE spinning and weaving of cotton for making clothing has been a well-established domestic industry in Sierra Leone from remote times; in fact, the so-called " Country " cloths, which are large and heavy pieces of material containing various designs worked in dyed cotton, were at one time a basis upon which a man's wealth was calculated.

During the last few years attempts have been made to produce a cotton suitable for the European market, and these have consisted chiefly in the introduction of various improved exotic cottons. None of these attempts, however, have so far met with any appreciable measure of success.

The most notable of these efforts was the introduction in 1924 of a considerable quantity of Allen Long Staple seed from Northern Nigeria. This was sown in various parts of the country, and the resulting crop was, on the whole, very unsatisfactory, ripening as it did at the height of the rainy season, and being heavily attacked by disease. Attempts have been made to overcome the former defect by later planting, but with unsatisfactory results. A number of plots of this seed were established at the Experimental Farm, Njala, and without exception they yielded very poor returns. In fact, this and subsequent experience led to the opinion that success was not likely to be attained from exotic cottons, and it was felt that the most hopeful line lay in the direction of an attempt by selection to improve some existing native type, and possibly afterwards to cross this with an imported cotton.

The type chosen for selection was " Quande " (Mende), which is a slow maturing plant with strong, white, somewhat short lint. The plants are on an average poor yielders, but are markedly resistant to disease when compared with imported cottons. Two other types are commonly grown by the natives in this district (Central Province), and frequently all three are mixed, but usually the plants are widely spaced in rice-fields. It was to be expected that any Quande seed obtained would be likely to show signs of interbreeding with the other

types. One of these has lint of a smoky colour and is called by the natives "Fandewai," and the other is a short, brown-linted cotton called "Nduli."

Source of Seed.—In February, 1925, permission was requested to collect seed in the district, but a bulk sample collected from white-linted plants was supplied from the Northern Province. It is believed that if the seed of individual plants could have been bagged separately at the outset, the first year's work might have been simplified.

Progress of the Work, 1925.—In 1925 the greater part of the seed was sown at the usual native planting time, early May. The remainder was sown later at regular intervals to obtain some indication of the best planting time for this cotton, and it was found that poor results were obtained from seed sown later than the middle of June.

This crop produced a certain proportion of plants bearing smoky coloured lint. It was also observed that such plants showed other distinct characters, and could be fairly easily recognized as the cotton described by the natives as "Fandewai." Careful observations were made on these characters with the object of removing plants bearing them before they should begin to flower in the next season.

During this period also selection of the white-linted plants was commenced. The plants were selected in the field after a rough examination of the lint as to whiteness, length, and strength, and yield was also taken into account in this and all the subsequent selections. Each selected plant was labelled and the seed bagged separately. Two groups were made, one containing the longer-linted white plants, and the other those picked out for white lint of good quality. The former group was distinguished by the letter A, and the latter by B, and six plants were selected in group A, and five in B. The main aim of the 1925 work was the elimination of the smoky lint and the production of a true-breeding white cotton.

1926.—In 1926 the seed of the plants selected in 1925 was sown in progeny rows (Groups A and B on separate plots), and the plants were again selected, this time both groups for length, strength, and whiteness of lint. Use was made of what had been observed in the previous year regarding "Fandewai" characters apparently correlated with the production of smoky lint, and plants showing these characters were removed before flowering, and a note made of the progeny rows from which they came. It was only necessary to remove six plants, three in A and three in B, and no smoky lint appeared in this crop.

No selfing of the plants was carried out in 1926, but selections were again made in the field after an examination of the lint. When

the final selections were made, account was taken of the progeny rows which produced the greatest number of good plants, and those from which plants showing "Fandewai" characters had been removed.

1927.—The seed of the selected plants from 1926 was again sown in progeny rows, and selfing was commenced. This was at first attempted by covering the plants with gauze bags, but it was early discovered that this method did not answer. The plants became "leggy," and the bolls were shed to a large extent. Fortunately, about this time information was obtained of a method which had been used with success in Nigeria.* This consists of tying the corollas just before they open, and in order to carry out the method the plots were visited twice daily, in the early morning and late afternoon. All flowers which were about to open were tied at each visit, and later, as flowers which had their corolla strings intact changed to the usual dark red colour, a piece of red tape was tied to the pedicels to mark the selfed flowers when harvesting. To ensure against mistakes all the seed was harvested when it ripened, but two bags were provided for each plant, one for selfed seed and the other for unselfed

After harvesting was completed the lint of all plants was examined. Measurements were made by taking the average length of single hairs spread on velvet, and rough estimates of the strength were taken. Desirable plants were then picked out.

In 1927 only one plant showing "Fandewai" characters appeared. This was allowed to mature, and it produced the usual smoky coloured lint.

In the selection from the 1926 plots B3/1 was retained, although this was the only plant selected from the progeny row B3. The reason for this was that B3/1 appeared to be a plant of exceptional quality. It was smaller than most of the other plants, but bore larger bolls with long lint, and was somewhat earlier maturing.† The progeny of this plant was sown in 1927 in an isolated plot and selfed. It is interesting to note that two of the plants in this plot produced naked seed—*i.e.*, with practically no "fuzz."

In certain cases the remainder of the seed of the strains from which plants were selected was bulked ready to be sown for the purpose of studying its behaviour under these conditions in the following season.

* "Improvement of Cotton in Southern Nigeria." C. J. Lewin. EMPIRE COTTON GROWING REVIEW, Vol. IV., No. 3.

† This last quality is not necessarily of advantage in Sierra Leone.

1928.—In 1928 the selected plants of the previous year were again sown in progeny rows in the usual way, and all were selfed by the method outlined above, while the bulked seed of some strains was sown in separate plots.

An exceptional flood took place in September, and a number of the plots were submerged to a depth of several feet. This resulted in the total destruction of some of the bulked strains, and severe damage to others. The breeding plot also suffered to some extent, but, although this plot was submerged to a depth of some inches for about a week, the plants withstood the conditions well and quickly recovered. The bulked strains which remained were: A1/1, A1/2, A1/3, B2/1, B3/1, B5/7. (See report from British Cotton Growing Association on these.)

The lint lengths of selected plants vary from 0·5 to 1·34 inches.

The table below gives some particulars of the bulked strains, and is followed by extracts from reports kindly furnished by the British Cotton Growing Association at various times.

BULKED STRAINS FROM 1927 SOWN IN 1928.

Strain.	*Average Lint Length in Inches after Removal of Selected Plants.*	*Lint Length of Resulting Crop.*	*Yield Per Acre in Lbs.*
A1/1	1·07	1·0	457·1
A1/2	1·05	1·0	224·07
A1/3	1·06	1·0	299·17
B2/1	1·08	1·06	21·6*
B3/1	1·09	1·12	360
B5/7	1·08	0·98	271·79

Yields calculated on basis of average yield per plant. Germination somewhat poor due to late planting and placing of fewer seeds per set.

BRITISH COTTON GROWING ASSOCIATION'S REPORTS.

1926. Average Samples of Groups A and B.

Group.	*Length.*	*Strength.*	*Value.*
A	$1\frac{1}{16}$ inches mixed with short	Strong	75 to 100 on
B	$1\frac{1}{16}$,, ,, ,,	,,	50 to 75 on

Based on American Futures at 7·15d.

1927. Average Lint Length for 1927 Crop 1·09 Inches.

Calculated on measurement of individual plants by B.C.G.A.

Severely damaged by flood.

1928. BULKED STRAINS FROM 1927 SOWN IN 1928.

Strain.	*Description.*	*Value.*	*Classification, etc.*
A1/1	Very good	90 on	Strict Good Middling, good colour, staple $1\frac{1}{16}$ inches, *very strong*
A1/2	—	25 on	Strict Good Middling, good colour, staple 1 inch, soft and wasty
A1/3	Good	75 on	Strict Good Middling, staple $1\frac{1}{16}$ inches, rather irregular and fairly strong
B2/1	Good, if not tinged	65 on	Good Middling, tinged staple $1\frac{1}{16}$ inches and $1\frac{1}{8}$ inches
B3/1	—	70 on	Good Middling, staple about $1\frac{1}{8}$ inches, but irregular, rather weak
B5/7	—	60 on	Strict Good Middling, rather tinged, staple $1\frac{1}{16}$ inches soft.

Based on American Futures at 10·42d.

For purposes of comparison, extracts are given below from the previous reports on samples of unimproved Quande Cotton submitted to the British Cotton Growing Association by the Agricultural Department:

Date.	*Length.*	*Strength.*	*Value.*
1925	1 inch	No remark	100 off
1926	1 „	„	Pass
1926	1 „	„	200 off

DISCUSSION OF RESULTS AND PROPOSALS FOR FURTHER WORK.—From the figures given above it is evident that a decided increase in the length of staple has been obtained, and the results are confirmed by reports from the British Cotton Growing Association. It will be observed—*e.g.*, in the Table showing results for the bulked strains—that the figures do not agree exactly with those given by the B.C.G.A., but they are consistent in that they rise and fall in practically the same way. Results have shown, however, that the methods employed in the early stages were sufficient for purposes of selection.

The yields shown for the bulked strains (see Table) are much higher than those usually obtained for Quande Cotton, and it is held that a definite improvement has been obtained in this direction also. According to the information available, this cotton yields from 90 to 100 lbs. of seed cotton per acre, and the yield of the original seed

from which breeding was commenced was 91 lbs. 1 oz. per acre. A number of individual plants on the 1928 selection plot yielded from 250 to 300 grammes.

Examination of the populations resulting from the bulked seed of the above strains made it clear that they are far from pure. It must be remembered, however, that the seed was bulked in 1927 at the end of the first year of selfing, and the populations are, therefore, the result of purity and improvement due only to two years of the work (1925 and 1926).

In 1928 no smoky-linted plants appeared either in the selection plot or the bulked strains, and it is believed that this character has been eliminated.

It is proposed that the work should be continued on the same lines, bulking for increase the seed of each strain after the selections have been made. Isolated plots will be necessary for this purpose, and therefore a considerable amount of land should be available.

When it appears that a satisfactory standard has been reached, or when the limit of improvement possible by this method seems to have been attained, the question of hybridization with imported cotton and the further selection of the progeny might be considered.

It is advisable that fresh material for selection should be obtained when possible, and with this object in view periodical tours should be made. In addition, selections could probably be made by some of the Agricultural Officers in various districts, and the seed cotton from the chosen plants forwarded for examination.

When the time comes to distribute the improved seed, it will, ot course, be necessary for the Agricultural Department to maintain a reservoir of this seed protected from contamination.

Some Difficulties Encountered.—Every crop of cotton has been attacked more or less by "Cotton Stainers," and in some seasons the attack has been very severe. This has, of course, detracted considerably from the commercial value of the lint. It has been remarked in practically all the reports from the British Cotton Growing Association that the lint was stained, and there is little doubt that the values assigned to the various samples would have been considerably higher had it not been for this defect. If cotton-growing is to be extended in Sierra Leone, it will be necessary to make an effort to deal with this pest.

Owing to the lack of a gin, up to the present time it has been necessary to carry out the ginning by hand. This has involved an immense amount of labour, and very careful precautions to prevent the mixing of the seed have been necessary. This state of affairs has

always led to late sowing, and as a result the bulked strains have not yet been established under the best conditions.

Finally, it has not been found easy to arrange for sufficient isolation of the bulked strains, and this question will probably present some difficulty in the future. Next year, with the additional information available from the behaviour of these strains, it will probably be possible to reduce the number considerably, and it is confidently hoped that a type suitable for distribution will be obtained in the near future.

Received January, 1930.

SEA ISLAND COTTON

A REVIVAL OF INTEREST

BY

JOHN A. TODD, M.A., B.L.

In all the discussion that has been going on recently about Outside Growths nothing is ever said about Sea Island. This is perhaps natural, because it is a very small crop, especially in recent years, and it has always been a very special market, entirely outside the experience or interest of the great majority of cotton spinners. Its wonderful quality and consequent high price have put it almost out of the category of cotton altogether, while the products in which it was mainly employed, especially lace, were hardly in competition at all with the ordinary fabrics into which cotton mostly goes.

For many reasons, however, this neglect of Sea Island cotton is unfortunate. Historically it is just about the most interesting cotton in the world. Domiciled originally in the West Indies (it took its name *Barbadense* from that island), it was almost our only source of supply of fine cotton in the early days of the cotton industry. Brought to the Atlantic States of South Carolina in 1786, via the Bahamas, it is said, it found a new home and a new name in the so-called " islands " off the coast near Charleston, which are really only detached portions of the mainland separated by backwaters; and from these it spread to the coastal portions of South Carolina, Georgia, and Florida, with the result that towards the end of the nineteenth century the crop had increased to about 120,000 bales maximum. The development of the finer varieties of Egyptian, especially Abassi and Jannovitch, encroached considerably upon its monopoly of the world's supplies of fine cotton; but these quickly made a new trade for themselves and left Sea Island still with its own domain at the very top of the scale. When about the turn of the century the sugar industry collapsed in the West Indies, the British Cotton Growing Association took a prominent part in the revival of cotton growing as an alternative crop, and the precious seed was literally smuggled back again to its original home. There it proved the salvation of some of the Islands, but it never took root successfully in any of the larger islands, and even in many of the smaller ones conditions proved unfavourable, for one of the peculiarities of the West Indies is the extraordinary variations of climatic conditions from island to island,

especially rainfall, and also of soil conditions. At the same time the sugar industry never entirely died out, and in many of the islands cotton only came in as a sort of by-product or catch crop, which had to be fitted in to suit the convenience of the major industry. The result was that the total Sea Island crop in the West Indies remained small, but before the war it had reached a total of about 7,500 bales of 400 lbs.

During the war cotton at first suffered very seriously, because its war uses were less important than those of other commodities, especially wool; and latterly the use of different cottons came to be more a question of possibilities of transport, in view of the submarine danger, than of the quality of the cotton itself. Sea Island of course suffered all the disadvantages of long sea transport through the most exposed regions, but its use for aeroplane cloth maintained its market to some extent.

The war, however, completely reversed the relative values of cotton and sugar, owing to the world being cut off from the continental beet-sugar supplies; and the West Indies became one of the few remaining sources of sugar supply, which of course reacted very severely on the production of cotton. Just when the war was over the whole position of Sea Island cotton was again transformed by the sudden disappearance of the Sea Island crop in America, through the advent of the boll weevil to the Atlantic States, and the West Indies suddenly woke up to find themselves the sole source of supply of the finest cotton. For a time Sea Island commanded very high prices in common with all other varieties of cotton, though hardly in its usual proportion, for Egyptian especially was in tremendous demand for the tyre trade, in which by this time it had entirely replaced Sea Island. But this period of high prices was very short-lived, and the slump of 1920-21 affected the luxury types of cotton even more than others.

It is rather remarkable that in view of the high price of Sea Island very little success has attended the efforts which were made to produce it in other parts of the world, where the conditions appeared to be similar. Sea Island has always been true to its name in that it will only grow successfully near the sea, but there are many other islands scattered throughout the Pacific where one would have thought that similar conditions could be found. As a matter of fact it has been tried in many of these islands and in parts of Central America, but with very little success. Fiji has produced a little at various times and there have been small crops in Papua. The other countries which own islands in the West Indies have also grown small quantities, and

when America acquired the Danish islands and became interested in Haiti and Porto Rico, Sea Island was also tried there. Recent developments in Porto Rico have been very interesting, and a small crop has been produced, mostly from Montserrat seed, which has caused a good deal of heart-burning among the other islands.

One reason for the failure of Sea Island elsewhere is that it has always been a crop which required the most meticulous care and extreme skill in its cultivation and handling. The real "Islands" cotton, and especially the best of it, known as "crop lots," was grown by a very few planters who had generations of experience behind them and took the greatest care of their seed supply. The proper handling of the crop was also very laborious, and only those who had the necessary skill acquired by experience could get the best results, so that even out of so small a crop the best was a very small proportion of the total. Only a few of the growers in the West Indies succeeded in reaching the same standard of skill that had been achieved by the best growers in the "Islands" district of South Carolina, but some of the West Indies cotton was undoubtedly as good as the best of the South Carolina crop. On the whole, therefore, Sea Island still remains practically the monopoly of the British West Indies, and it is some satisfaction to know that the Empire possesses an undoubted advantage in this direction.

The great disadvantage of Sea Island cotton has always been that, as it is so entirely a special market, it suffers particularly from the conditions both as to supply and demand, which affect it peculiarly. The supply has always been subject to extreme fluctuations, because both in America and the West Indies the crop was liable to be almost wiped out at times by local hurricanes. It was therefore a very speculative crop from the growers' point of view, and this was accentuated by the uncertainty of the demand. The high prices made it impossible to use Sea Island yarns except for lace and for those superfine fabrics the price of which puts them almost on a level with silk. The demand for these specialities has always been very unreliable, because like lace they are so much a matter of fashion, and recent changes in women's clothing have hit this particular demand very hard. The most remarkable development in the demand, however, was when the American crop failed so suddenly about 1918-19. It was to be expected that the sudden reduction of the supply would create a famine in the demand, but the times were unfortunate, and as a matter of fact the trade apparently never missed the American crop. For one reason there were large stocks in hand at the time, but the main reason was that the trade found it possible to shift over

to the best varieties of Egyptian Sakel, which even before then had been competing to a considerable extent with Sea Island, both in the lace trade and in the production of the finest fabrics. Even before the war substantial quantities of so-called Sea Island yarns made entirely from Sakel were being sold in the Nottingham district, and the trade apparently found them good enough for the purpose and made no protest.

The effect of all this on the growers of Sea Island was very unfortunate. For a time their wonderful product seemed to become a drug in the market, and they found themselves in the hands of a very limited number of consumers who, having already laid in large stocks, could only be persuaded to take the crop off their hands at what seemed to the growers very unsatisfactory prices. The result was inevitably an agitation to restrict the area under Sea Island in the West Indies, and as long as sugar was commanding good prices the suggestion met with a good deal of support. Many of the islands, however, could not easily adopt this policy, and the question was raised whether other varieties of cotton could not be produced in the islands which would be less subject to the peculiar disabilities of Sea Island cotton, and, though of poorer quality, would in the long run pay the growers better. So far the search for such a substitute has not met with any success. The only local alternative, Marie Galante cotton, is very much inferior in quality; and it is doubtful whether it possesses any countervailing advantages in larger yield or easier growth. A few of the islands (especially Grenada and Carriacou) still grow almost nothing but Marie Galante, but if the proposal to adopt it generally is to be seriously considered, it would require a long course of investigation and development before a satisfactory supply of seed could be produced, for Marie Galante has only been grown under the least careful conditions, and the existing seed supplies are very badly mixed. As to any other type of cotton, Egyptian is believed to be entirely out of the question owing to its susceptibility to black arm disease, under the humid conditions in which Sea Island flourishes; while the other long staple varieties, such as the Mississippi Delta types, are not regarded with favour because the world's supply of that class of cotton is already very large, and is indeed likely to become almost excessive through the rapid increase of the Egyptian Uppers crop, which is its nearest rival.

The fact that Sea Island cotton has always been regarded as to some extent occupying a water-tight compartment, separated from the rest of the cotton world, has resulted in an attitude of aloofness on the part of the growers which has its disadvantages. They have

always been told, and have come to believe, that the price of their cotton has nothing to do with world prices, which are dominated by American cotton. In recent years, however, there have been certain new developments with regard to both the supply and demand which make it necessary to modify this attitude. In the first place the conditions under which Sea Island is being produced have been changing. The introduction of new varieties of seed, especially "Heaton" in Montserrat, and changes in cultural methods, particularly in the dates of the cotton season, have resulted in a definite increase of the average yield which can be obtained, and figures as high as 350 lbs. an acre are now spoken of in some of the islands. At the same time the struggle aganst the pink bollworm, which a few years ago looked almost like wiping out the crop, seems now to have met with a considerable amount of success, which tends in the same direction. The point is that a larger yield means a lower cost of production, and some of these new varieties, especially Montserrat, have proved very acceptable to spinners who want a fine cotton, but not quite so superfine as the very best of the old Islands types.

This change in the supply and cost of production has coincided with a slight revival of demand in certain directions, which looks hopeful. The lace trade has recently enjoyed a distinct revival, but unfortunately the types of lace which are now most fashionable are not those in which Sea Island is essential. There is still, however, a small but steady trickle of demand, and in the finer woven fabrics in which Sea Island is used there has also been a certain return to popularity which has resulted in increased demand. In another direction, however, there is some possibility of a more substantial increase of consumption. Fine cottons have always been used in the manufacture of stockings, and in recent years with the increased use of silk and of artificial silk these have become finer and finer. Latterly there has been a distinct reaction in fashion against the cheaper grades of artificial silk stockings, and ladies are beginning to realize that a better article can be produced from fine cotton at a lower price than cheap artificial silk goods. This tendency has perhaps been particularly strong in America, where "sheer" stockings are much in vogue. So far the Germans have taken the lead in this trade in Europe, for they have always used machines of finer gauge than the general run of those employed by the British manufacturers. Some of them have latterly been using Sea Island cotton on a considerable scale, though it is unfortunately equally true that large quantities of so-called Sea Island stockings are made from Egyptian yarns. A recent development of much interest to the West Indies has been the presence

in certain of the islands of direct buyers from the United States who have been taking quite considerable quantities, especially of Montserrat cotton, though the purpose to which this cotton is being applied has never been stated.

On the whole, therefore, there are distinct signs of an improvement in the demand for Sea Island cotton, and it is equally certain that the supply could be increased to a moderate extent if the permanence of this demand were assured. Unfortunately, however, it is too soon to assume that, and it would be a great pity if in the meantime the growers were misled into increasing their acreage very largely. After all the demand for Sea Island is still very limited, and a relatively small increase in the supply might easily overtake the improvement, which so far can hardly be described as more than tentative.

Year.	*U.S.A. (500-lb. Bales).*				*British West Indies (400-lb. Bales).*
	Florida.	*Georgia.*	*South Carolina.*	*Total.*	
1899	31,238	57,812	8,229	97,279	—
1900	28,066	52,079	8,149	88,294	—
1901	27,765	42,497	7,617	77,879	—
1902	31,989	60,021	12,943	104,953	757
1903	27,840	37,612	9,941	75,393	1,035
1904	39,619	53,112	11,586	104,317	1,938
1905	41,531	58,311	12,697	112,539	2,998
1906	23,995	25,484	8,071	57,550	4,157
1907	28,935	44,713	13,247	86,895	6,563
1908	34,775	44,549	14,534	93,858	6,870
1909	28,158	52,060	14,573	94,791	5,649
1910	29,417	47,935	13,016	90,368	5,318
1911	41,270	72,904	5,119	119,293	7,562
1912	22,334	43,736	7,707	73,777	6,173
1913	25,587	43,305	8,671	77,563	6,477
1914	33,662	42,395	5,597	81,654	5,812
1915	28,094	57,572	6,178	91,844	5,882
1916	36,092	77,981	3,486	117,559	3,678
1917	37,327	47,979	7,313	92,619	3,157
1918	20,571	21,279	10,358	52,208	6,086
1919	2,787	684	3,445	6,916	6,170
1920	1,236	383	249	1,868	4,831
1921	2,573	611	143	3,327	4,073
1922	4,886	158	81	5,125	5,160
1923	—	—	—	785	5,031
1924	—	—	—	11	4,051
1925	—	—	—	18	5,148
1926	—	—	—	23	5,909
1927	—	—		179	6,076
1928	—	—	—	22	4,322

Received February, 1930.

GINNING TECHNIQUE AND COTTON QUALITY

BY

HORACE SPIBEY, M.Sc. Tech.,
College of Technology, Manchester.

PART I.

The process of ginning, with its influence on cotton quality, has long been under consideration without much definite progress having been made towards a solution of the many problems appertaining to the existing technique. Recently a greater significance has been attached to the effect of ginning and its variations on the physical properties of the lint. The Division of Cotton Marketing, U.S. Bureau of Agricultural Economics, in co-operation with the Texas Agricultural Experiment Station, is, it is understood, now making detailed studies on cotton on these lines. The investigations have been initiated chiefly as a result of the many representations which have been made to the Department of Agriculture from various sources, both in America and elsewhere, pointing out the gradual deterioration in the ginning preparation of American cotton. The studies and investigations of the Bureau will be conducted with a view to showing what is happening to the cotton under various ginning conditions and operations. Although the investigations will be conducted solely on American cotton, and under American conditions, the results will be of great interest to all cotton growers and ginners, irrespective of their location or their conditions of cultivation or processing.

That many cottons are seriously reduced in quality in consequence of defective ginning will probably be generally admitted. At the same time, however, it is important to bear in mind the variations in response which different cottons present to ginning, variations which are often insufficiently realized and accordingly create troublesome, but nevertheless avoidable, defects in the lint. The necessity, therefore, for a clear understanding of both cotton and machine will be patent. A study of the former so far as ginning influences are concerned constitutes a wide and comprehensive field for scientific investigation and research. That such an undertaking would be complicated will, of course, be recognized, for a great many factors are involved and their inter-relationship is very complex. The

wide variations in the cotton itself, in respect of general fibre characteristics, staple length, and impurity content may, for example, be cited as important factors which influence the ginning technique and the results.

CHARACTERS OF THE COTTON.

Changes during Storage.—The physical changes which the cotton undergoes during its brief period of storage prior to ginning, and the influence of these on grade, strength, resistance to nepping, pliability, etc., have often been discussed, but unfortunately have met with little scientific study. The importance of these changes will be apparent from the following extract out of a report by N. S. Pearse on the 1928 U.S.A. Cotton Crop. * "The ginning of cotton without permitting a duration of storage not only makes for neppy cotton, but the lint has no opportunity to absorb oil from the seed whilst waiting to be ginned, thus failing to obtain the specially prized rich and glossy feel and creamy appearance. It is well known to Memphis cotton buyers that seed cotton stored for a week or ten days gives a better grade and a stronger lint than cotton ginned the same day as picked." Although these comments relate essentially to a particular type of cotton, they are nevertheless generally applicable in varying degrees. Additional evidence of the importance of pre-ginning storage may be found in a report recently issued to cultivators, wherein it is stated that in certain parts of the U.S.A. cotton belt disregard to this results in an annual loss of ten dollars per bale. Enough seed cotton to make ten 500-lb. bales will, it is stated, make eleven bales on the same gins if stored away for about sixty days.

Moisture Content.—A further factor which exercises no mean influence on ginning technique is that of moisture content, varying as it does from 3 to 14 per cent., according to the general atmospheric conditions and the prevalence of drought or excessive rain. It would, however, be of secondary importance but for its great influence on the fibre characteristics, and upon the response of the lint to ginning. The bad effects of ginning damp cotton have often been discussed and they are probably well known by the majority of cotton ginners, who often, unfortunately, find their policy dictated by other factors or conditions. The error of damp ginning is rendered apparent by the precaution observed by some cultivators and ginners of the longest stapled cottons, who cease operation altogether even in damp weather. Although a high moisture content is decidedly detrimental to ginning technique, it is maintained by many practical ginners that cotton may be ginned too dry. What then is the

* N. S. PEARSE: "Retrospect of the 1928 U.S.A. Cotton Crop."

maximum and minimum, or what is the optimum, moisture content for most satisfactory ginning? There can be no doubt of the fact that much of the neppiness created at the gin arises from processing whilst moist and "green."

Degree of Maturity.—The condition of the cotton, in respect of its degree of maturity, may be mentioned as a further influence on the quality of the resulting lint. The question of maturity is one of considerable complexity, and much difference in this respect is found between various cottons. The inherent susceptibilities of certain cottons to immature development have been extensively studied in regard to their proneness to nepping. The actions involved in ginning, either saw or roller, are particularly favourable to the conversion of immature hairs into neps, with the result that a close comparative inspection of the lint will generally permit of an accurate estimation of the lint value, although in certain instances it is found that nep formation requires the mechanical action of the gin to be supplemented by that of some subsequent process. In other words, the celerity of nepping is rather a fluctuating factor in different cottons, other things of course being equal.

Growing and harvesting methods also demand consideration as factors of influence on cotton quality, and here again appreciable differences are encountered in the methods by which these operations are performed.

Variations in Ginning Practice.

It will be observed that the various factors discussed above all react on the character of the ultimate lint, irrespective of the efficiency of the ginning operation, and in consequence of their extreme fluctuations they serve to complicate the study of the inter-relationship of fibre characteristics and ginning technique. But differences also exist in the ginning operations and the cleaning machinery, recent developments therein tending, if anything, to increase the variable nature of the ginning and cleaning practice. For example, various combinations of cleaning equipment may be installed—line cleaner, cleaner feeder, large drum-cleaning feeder, small drum-cleaning feeder, and huller breast. Many gins, in fact, have no cleaners, whilst some have one and others have two or more. Among other factors associated with, and adding complication to, a study of the ginning operation the following may be mentioned: diameter of saws; speed of saws; number, pitch and condition of the saw teeth; density of the seed roll; ratio of the speeds of saw and seed roll; method and efficiency of removing lint from the saw teeth; condition and setting of the gin

ribs; rate of feed, etc. The divergence of opinion found in working practice, in the aforementioned details, probably gives rise to as much misconception and inefficiency as an inadequate consideration of their importance. To stipulate, however, the best conditions for these factors would be impossible, for the numerous and variable elements which are introduced into the operation, and are quite exotic to it, must be given due regard so far as their influence on the ginning process is concerned. Reports of visits to cotton growing and ginning centres often comment upon the unsatisfactory or inefficient way in which the process is conducted, the damage which the cotton suffers in respect of cutting, nepping, stringing, etc., and the excessive shortening of the lint length.

Cleaners.—At this juncture, therefore, a consideration of orthodox saw-ginning practice, and variations therein, will be of interest. The installation of some kind of cleaner for imparting a pre-ginning cleansing to the seed cotton is becoming more popular. The general principle of the action is to agitate the cotton on a wire screen or grid of $\frac{1}{4}$ to $\frac{1}{2}$ inch mesh, thus permitting dirt, sand, leaf and other foreign impurities to escape. Reference may also be made to the occasional introduction of a boll-breaking attachment which co-operates with the cleaner and serves to break open those bolls whose natural opening has been prevented or retarded in consequence of unfavourable climatic influences. This feature is prevalent in certain of the more recently developed cotton-growing localities, and is peculiar to certain varieties of Turkish and Asia Minor cottons. Although very undesirable, it is by no means as detrimental to the lint and spinning values as may initially appear. The adoption of the practice of snapping and sledding in harvesting, confined in the main to certain sections of the cotton belt of the U.S.A., has rendered the introduction of cleaners an important practical necessity, and has exerted much influence on the designing of machines solely for this purpose, as well as on the modification of gins. That the application of cleaners to hand-picked cotton for the purpose of enhancing the grade has, on occasion, had the ultimate effect of deteriorating the value of the lint, will be readily admitted by many ginners. The misuse of cleaning processes has frequently formed the basis of complaint by merchants and spinners. The pre-ginning application of cleaners, in which no harsh mechanical beating is performed, is however, usually preferred to the immediate and post-ginning adoption of a Crighton or other form of cylinder opener—a procedure which is comparatively rare, but, in the majority of instances, affects to no mean degree the appearance and " bloom " of the lint.

Feeders.—The system of feeding the gins depends on the size and number of the machines, although, wherever permissible, the pneumatic method is preferred and a battery lay-out of the gins is adopted to facilitate this end. The feeder receives the seed cotton from a pneumatic elevator or belt distributor located above it, and delivers it at a regular and even rate to the ginning roll box.

Feeders, generally speaking, may be divided into two types. Firstly, the horizontal lattice or belt type (Fig. 1), which receives the seed cotton from the belt distributor or pneumatic elevator on a slow-moving belt and moves it horizontally to a spiked roller, 9 to 11 inches in diameter, rotating at 180 to 200 revolutions per minute, and provided with spikes projecting from 1 to 1¼ inches from its periphery. These spikes loosen up the seed cotton as it is thrown over and into the chute leading to the ginning roll box. The second type of feeder receives the seed cotton from the elevator chutes or belt distributor on two fluted rollers, 5 to 6 inches in diameter, rotating towards each other at the very slow rate of ½ to 1 revolution per minute. In this way the cotton is fed slowly in a downward direction to a spiked roller, similar to that described in the previous case, which, by its high rate of rotation, co-operates with a wire grid (⅓-inch mesh and placed at a distance of ½ to 1 inch from the roller) to effect the removal of sand, leaf, etc., prior to the passage of the seed cotton to the roll box. The superiority of the latter type in respect of cleaning capacity will be very apparent, and the latest improved feeders constitute effective cleaning units, particularly in the treatment of lower grade cottons.

The principal unit of the ginning equipment is the gin stand, performing as it does the main work of separating the lint from the seed, and, according to its construction, so will the machine be designated either plain gin or huller gin. The main working parts in both types of gin are the saws cylinder, roll box, and a means of removing the lint from the saw teeth after the ginning has been performed.

Plain Saw Gin.—The plain gin (Fig. 1), employed only for clean seed cotton which is reasonably free from bolls and trash, is the original type. The standard machine contains 70 or 80 steel circular saws, 10 to 12 inches in diameter, and 0·035 inch thick, mounted on a $2\frac{3}{16}$ to $2\frac{7}{16}$ inch mandrel and uniformly spaced by wooden or iron spacing blocks, which are 0·6 to 0·8 inch thick, 4¾ inches diameter for 10-inch saws and 6 inches diameter for 12-inch saws. Practice, it would appear, is definitely in favour of the 12-inch diameter of saw. The saw teeth, which all incline in the direction of rotation, are spaced normally with 7 teeth per inch, the teeth being

punched out and then filed smooth. The effect of this mode of construction, however, is to crystallize the saw steel to a certain extent and, in consequence, create defective teeth with rough edges which, although imperceptible to the naked eye, are clearly visible under magnification, and in practice are very conducive to the formation of neps and gin-cut lint. With a view, therefore, to ensuring a perfectly smooth tooth, free from fracture and crystallization, provision is made in manufacture for milling or grinding. The shape of the tooth is a feature on which much time and study have been spent with a view to securing the best possible working conditions, and the usual practice is to make both the front and back edges perfectly straight. In certain instances, however, the front edges retain their straight condition, whilst the back or upper edges are made convex. The inclination of the edges of the teeth and the angle of the point represent further variables which are governed by certain working conditions, to which reference will subsequently be made. The inclination of the front and back edges with a radial line through the point may, under ordinary conditions, be regarded as varying from 36 to 40 degrees, and 53 to 60 degrees respectively, the two edges making an angle of 20 to 24 degrees with each other at the point. The speed of the saws is, perhaps, the most variable factor in the manipulation of gins; at any rate, there can be no denying the fact that this factor is responsible for many of the faulty results of ginning. Under ordinary conditions a surface rate of 1,000 to 1,250 feet per minute for brush gins, and 1,400 to 1,900 feet per minute for air-blast gins, may be regarded as orthodox practice. The construction of the ginning roll box, generally speaking, is of a standard nature, although in the more minute, but nevertheless important, details much variation is found. The roll box, which in the course of its development has undergone considerable modification, consists essentially of a series of ribs or grate bars between the saws, with a half rib at each end, a back hollow above the ribs, an inlet or feeding aperture at the top, and a front cover supporting an adjustable seed plate.

The location of the roll box directly above the saw shaft likewise has become standard practice, its dimensions permitting of a seed roll which is approximately the same diameter as the saw discs and which rotates at about one-quarter to one-fifth the speed of the saws, depending, of course, on the density of the seed roll. Although in theory the roll assumes a circular formation, it is found in actual practice that working conditions create no mean degree of distortion —a condition which influences within narrow limits the lint absorption from the roll. It is generally regarded as best practice to secure a

seed roll which is as soft and yielding as reasonably permissible in order to avoid the lint wedging and choking the throats of the saw teeth, thus minimizing cutting and nepping and also permitting a more facile release of the lint from the surface of the seed roll. The importance of the last mentioned point is probably far greater than is generally supposed, although it must be conceded that the degree of importance will vary with the type of cotton under treatment. Empire cottons, generally speaking, demand more attention to this detail than ordinary classes of North or South American cotton. The relationship of the saw speed and roll density also must demand careful consideration in obtaining satisfactory defibration of the seed, the precaution in respect of roll density becoming more acute with high saw speeds.

The projection of the saws into the roll box is a feature of considerable moment, and for orthodox ginning practice varies from $1\frac{1}{16}$ to $1\frac{6}{16}$ inches, a distance of $1\frac{4}{16}$ inches being most favoured.

The construction of the ribs is more or less standardized, cast iron being employed, with a certain section of the ribs, where the saw teeth pass between them, chilled so as to make a hard and durable working surface. Ordinarily a distance of 0·125 inch is adopted for the spacing between the ribs at the point where the teeth pass through, the distance increasing in each direction from this point. For obvious reasons it is necessary to grind smooth and polish the wearing surfaces and edges of the ribs, if imperfect ginning is to be avoided.

The regulation of the degree of delinting, or ginning, is an important factor for which due provision is made in the majority of saw gins by the inclusion of an adjustable seed plate, located on the front cover of the roll box. The release of ginned or clean seed is partially permitted by so shaping the profile of the front cover that a loosening of the roll occurs at this point. The mounting of the seed plate just below this position, however, permits of the required control being obtained. The fingers of the plate project between the saws and extend for $\frac{1}{4}$ inch inside of the circular path of the saw teeth, the exact position being decided by and adjusted according to the degree of ginning desired. The raising of the plate causes the fingers to press on the underside of the seed roll, thereby retarding the shedding of the seed and in turn effecting a cleaner ginning. The lowering of the plate, on the other hand, facilitates the release of the seeds, the setting sometimes being carried out to such an extent that the seed is released prematurely and before the lint is entirely removed. The regulation of the degree of ginning, influenced as it is by this setting, demands due consideration, and in this respect

every cotton must be regarded by itself, conditions being adopted accordingly. In passing, it is important to note the relative positions of roll box centre and saw shaft centre, the former being sufficiently in front of the vertical centre line through the latter to assist the shedding of the seed from the roll box.

Huller Saw Gin.—The huller gin, to which brief reference has been made previously, is constructed for dealing with seed cotton containing much impurity, the seed cotton being separated from the bolls, burrs, leaf, dirt, and other foreign impurities in a front and lower roll box prior to its being carried to the upper roll box, where the separation of lint and seed is performed in the ordinary way. It will, therefore, be seen that a double ginning operation is performed. The *modus operandi* of the huller saw gin is very similar to that of the plain gin, so far as the more important phases of the operation are concerned. The design and construction of the roll box are practically identical in the two machines, the only important exception being that the huller roll box precedes the ginning roll box, and the seed cotton is fed to the huller box first. The feed to the ginning roll box, therefore, is from below instead of from above, as is the case with the plain gin. The huller roll box itself consists of a chamber, the lower end of which carries an adjustable and hinged front cover with an inclined sheet or board for regulating the refuse discharged, and a huller picker roller rotating in the same direction as that of the saws to effect a separation of the trash and seed cotton and also throw the latter into the path of the rotating saw teeth. To effect these functions the roller, usually termed a huller picker roller, is constructed with a diameter of 2½ to 4½ inches and with 10 to 16 longitudinal rows of spikes, set at an angle of 30 degrees to the radius of the point where they enter the circumference of the roller. These spikes, which project from ¾ to 1 inch, are arranged in alternating order, in circular rows of five to eight spikes between each pair of saws. In certain constructions the huller box is furnished with a second spiked roller placed some distance above that previously described, so as to obviate, as far as possible, the incidence of choking by regulating the amount of seed cotton taken from the huller compartment by the saws. The huller ribs, which partially surround the huller picker roller and prevent the hulls from being carried into the upper roll box, are usually so arranged as to allow the outer or working surface of the ribs to fall from ¼ to ⅜ inch below the tips of the saw teeth, the bottom ends of the ribs being fixed to a rib rail. The spacing of the huller ribs at their working part is sufficiently wide to permit the seed cotton to pass through with some measure of

facility, and prevent cutting and fracture of the seeds. The adjustments and settings of the huller compartment details merit some consideration if the machine is to function as intended, and satisfactory removal of hulls and trash is to be effected. For example, the setting of the front cover in relation to the huller picker roller, and the setting and relative speeds of huller picker roller and saw discs, demand proper attention in relation to the type of seed and lint, the nature and amount of hulls and trash in the seed cotton, and so on.

The extreme range of speed for the picker roller is usually 300 to 700 revs. per minute, depending on the factors previously enumerated. The distance between front cover and picker roller will clearly determine the discharge of the impurities, which, of course, should be a maximum without, however, permitting the undue falling out of locks of seed cotton. In the case of cottons containing a high proportion of foreign matter, the picker roller is often set further away from the huller ribs and a corresponding alteration made with the setting of front cover and picker roller, thus allowing the trash to be shed out at two points—viz., before and behind the picker roller. For cottons which contain but small quantities of hulls and trash it is advisable to set the roller close up to the front cover and saws, to avoid the expulsion of seed cotton. It may, of course, happen that only a part of the trash is shed out, and as the quantity increases the box front must be swung out manually to effect a complete discharge of the foreign substances. In obtaining satisfactory and expeditious discharge of impurities reference may be made to the importance of correct angle of the spikes on the picker roller, correct spacing of the roller to the front cover and huller ribs, correct angle of the front cover, and a proper speed of the picker roller. Much difficulty is often experienced in actual practice in securing the best working conditions from the huller roll box, and full advantage is not always obtained from its application. A careful examination of the ginned lint, initial seed cotton and trash extract, collectively and individually, will reveal the measure of utility which is being obtained from any huller roll box. A systematic analysis of these will indicate from a qualitative aspect the degree of efficiency of the huller box, the use of which has developed considerably in certain cotton-growing areas within the past few years, and particularly where mechanical picking methods have been instituted. Although the influence of developments in picking methods on ginning technique falls outside the scope of this article, it does, nevertheless, merit brief mention.

(*To be continued.*)

A. Feeder.
B. Roll box.
C. Breast.
D. Saws.
E. Grate bars.
F. Seed plate.
G. Adjustment screw for seed plate.
H. Front division plate.
J. Brush.
K. Adjustable mote plate.
L. Brush stripping plate.
M. Condenser cage.
N. Press roller.
O. Condenser stripping plate.

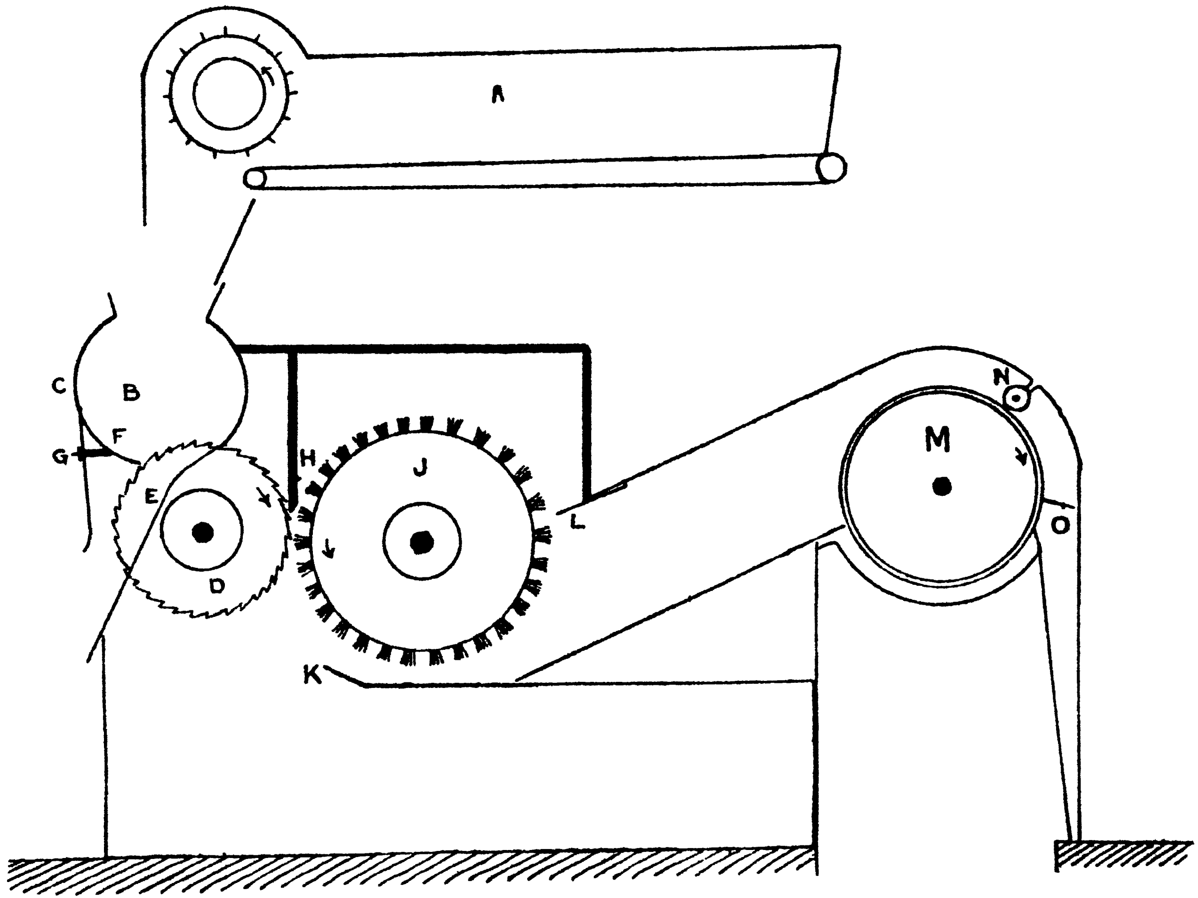


FIG. 1.

PLANT DEVELOPMENT CURVES AND THE BRANCHING OF COTTON

BY

N. W. BARRITT, M.A.

(*Rothamsted Experiment Station*).

The keeping of continuous records of the daily growth, flowering and fruiting of cotton plants was introduced by Balls in Egypt some twenty years ago, and has since been adopted by most students of cotton-growing. The application of statistical methods to biological problems is unfortunately beset with numerous pitfalls for the unwary, and though the results of observations may certainly be rendered more interesting when expressed in graphs or formulæ, they do not thereby become more significant. Balls[1] claimed that the curves for growth of main stem, number of flowers opening, and number of bolls ripening closely resembled each other, and that it was possible to forecast the crop some two and a half months in advance. These same curves also led him to assert that under Egyptian conditions excessive growth due to manuring never gave rise to a reduced yield of cotton.

Whilst it is true that the final yield of the crop has been reached by a process of building up stage by stage and organ by organ, there are considerable losses in the process. Further, the growth curve described by Balls only represents the rate of elongation of the main stem, which is a very different thing from the increase in weight.

Bailey and Trought[2] by a series of carefully conducted experiments showed that the growth of the cotton plant in Egypt, like that of any other plant, is dependent on assimilation, which has no relation to rate of elongation. Their results showed that the flowering curve did not follow the growth curve at an interval of twenty-three days as claimed by Balls, nor at any other interval. Forecasting from such data is obviously misleading.

The Flowering Curve in Relation to Yield and Quality of Cotton.

The flowering and bolling curves, however, have their uses as records of the manner in which the crop is produced. They have naturally assumed considerable importance with workers in Egypt, who have rather come to believe that the ideal plant should have a steep and narrow flowering curve, so as to ensure an early crop

capable of being picked almost in one operation. This belief appears to be based chiefly on the fear of the pink boll worm, notwithstanding the fact that Williams[3] in 1926 showed conclusively that the increase in the boll worm always kept pace with the growth of the crop. This supposed superiority of the steep flowering curve also led Templeton[4] to believe that ratoon cotton might be better than annual. He has also more recently described the form of branching of the ideal cotton plant as one ensuring a steep flowering curve.

For scientific study it is necessary to substitute statements of observed fact for mere expressions of opinion. Some facts bearing on this subject and observed independently are contained in a recent paper by C. H. Brown.[5] He gives the results of two new strains of cotton grown side by side in four different localities in Upper Egypt, without apparently realizing their significance. Samples of the cotton were sent to the Fine Spinners' Association Research Laboratory for spinning tests, the results of which are given in the following table;

Locality.		*Per Cent. of Total Waste.*	Mean.	*Count Strength Product.* Twist Factor 3·25.		Twist Factor 3·75.	
Fashn	Giza 2	19·1	19·7	1,816	1,857	2,118	2,142
	Giza 3	20·3		1,899		2,166	
Mansafis	Giza 2	20·7	21·5	1,839	1,834	2,091	2,105
	Giza 3	22·3		1,830		2,119	
Maragha	Giza 2	23·1	24·7	1,804	1,788	2,117	2,105
	Giza 3	26·3		1,773		2,094	
Giza	Giza 2	22·7	23·4	1,572	1,688	1,934	2,026
	Giza 3	24·2		1,805		2,118	

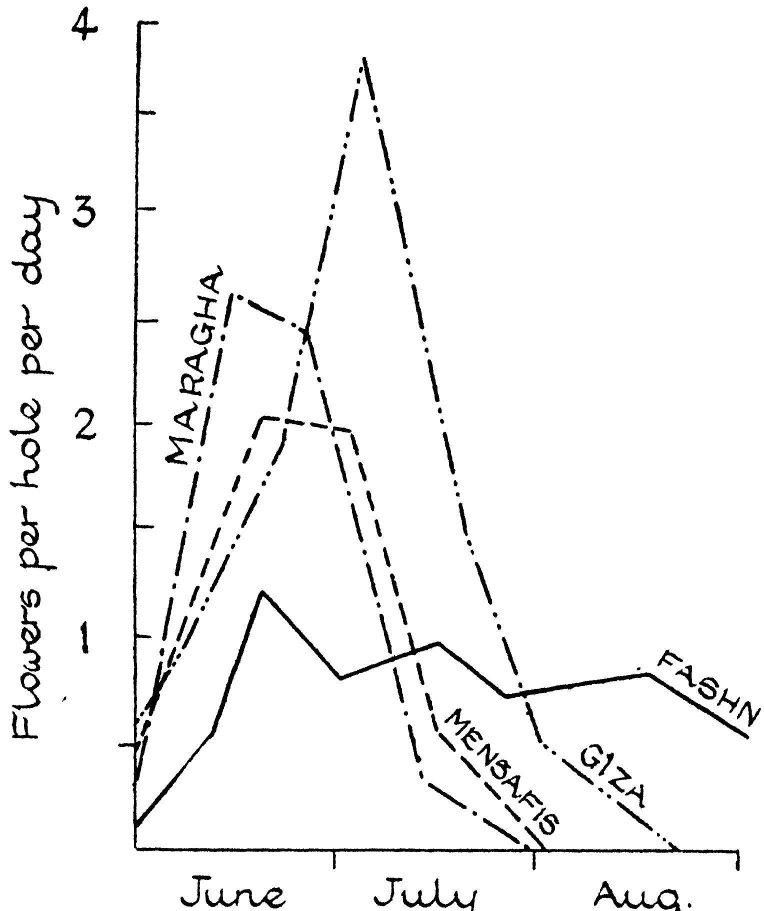
The results are arranged in order of their mean yarn strengths, and it will be seen that the percentage waste figures show a progressive increase as the strength of the yarn decreases. Both strains of cotton give the best results at Fashn and the worst results at Maragha and Giza.

The yield figures in kantars per feddan of the same plots are as follows:

	Fashn.	*Mansafis.*	*Maragha.*	*Giza.*
Giza 2	9·61	9·15	8·51	6·27
Giza 3	8·41	8·32	8·72	5·62

It will be seen that the yield figures follow those of the spinning tests—*i.e.*, the best cotton in both yield and quality is produced at Fashn and the worst at Giza.

Brown also gives the flowering curves of both strains of cotton in each district but makes no comment on them. Though the two strains Giza 2 and Giza 3 are of entirely different pedigrees their flowering curves are almost identical in each locality. The mean curve for each locality is given in the following diagram.



Flowering Curves in Four Different Localities in Upper Egypt 1927.

Average of Four Varieties of Cotton.

It will be seen that the flowering curve at Giza is the steepest, and therefore the ideal one according to Templeton, whilst the curve

at Fashn is almost flat. In both yield and quality the broad or flat flowering curve is definitely superior to the short steep curve. These curves also show in a most striking manner that the character of the flowering curve is dependent more on the environmental conditions than on the strain of cotton.

The belief in the superiority of the steep flowering curve may therefore perhaps be relegated to the limbo whither several venerable fictions have already been dispatched, such as the dicta that full fuzz indicates quality and that long staple cottons cannot be grown in Upper Egypt.

Bud Shedding and Branching.

One of the most striking features of the cotton plant in all countries is the readiness with which it sheds buds, flowers and bolls when subject to adverse conditions. Balls[6] accounted for this abscission by the formation of a cork-layer similar to that occurring with autumnal leaf-fall of deciduous trees. C. P. Dutt,[7] however, has shown that this explanation is not supported by the observed facts, since no cell division occurs in the absciss layer, and that abscission is effected by a rapid disintegration of the cell wall by enzyme action. The simplicity of such a process provides a quick response to adverse conditions and probably accounts for the rapidity with which it occurs. Excessive moisture or excessive dryness of the soil may produce the adverse conditions giving rise to abscission, which is no doubt a mechanism for maintaining a proper physiological balance between root and stem.

Any practice by which this shedding can be minimized and by which bolls could be brought to maturity would be a great advantage. Obviously the control of the moisture content of the soil by means of cultivation and irrigation is the first essential.

Attempts to modify the branching system of the plant by pruning must almost of necessity fail to reduce shedding. Pruning or topping before flowering begins will increase the number of shoots or branches without increasing the supporting root system, and will consequently increase the danger of water strain in the plant. Pruning after flowering is too late, since the greatest danger of shedding occurs in the flower bud stage, and the removal of fully developed branches will only reduce the assimilating powers of the plant and thereby check maturation of the bolls.

Any idea of pruning to increase bud formation, as in the case of fruit trees, ignores the fact that cotton plants always produce more flower buds than can be brought to maturity. An increase in

the number of effective flowering branches can be more successfully obtained by increasing the number of plants per unit area of soil, whereby the root system is increased in like proportion to the branches. The problem thus becomes one of the optimum spacing conditions.

Following his work on ratoon cotton in Egypt, Templeton[8] has investigated the branching and the effect of topping or pruning at different stages in the growth of the plant. In pruning for ratoon cotton he claimed an increased yield of 100 per cent. or more over the control, but the controls were so obviously abnormal that no safe conclusions can be drawn. The yields obtained by topping annual plants have not yet been published (see Report of Cotton Research Board, Egypt, 1927), though in his recent paper on branching he hints at special methods of increasing the yield, to be divulged later.

Bailey[9] carried out similar experiments in the Sudan and recorded decreased yields due to topping at all stages of growth.

Some explanation of the connection between the type of flowering curve and quality in cotton may now be attempted.

The effect of increasing the number of branches is to render the flowering curve more steep—*i.e.*, more flowers open on the same day, and if the bolls survive more of them are maturing at the same time on the same plant. Such bolls must necessarily be competing with each other for the available carbohydrates, and any temporary shortage which is not corrected by a reduction in the number of bolls by shedding will result in the starvation of the developing lint, as explained by the writer elsewhere.[10] This competition associated with a steep flowering curve accounts for the inferiority of the cotton grown at Giza and Maragha compared with that grown at Fashn. It also explains the lower strength of ratoon cotton recorded by Summers.[11]

REFERENCES.

1 BALLS, W. L.: "Development and Properties of Raw Cotton."

2 BAILEY, M. A., AND TROUGHT, T.: "Growth, Bud Shedding and Flower Production in Egyptian Cotton." *Bull.* 65, *Ministry of Agriculture*, Cairo, 1926.

3 WILLIAMS, C. B.: "Seasonal Variation in Pink Boll Worm Attack." *Bull.* 67, *Ministry of Agriculture*, Cairo, 1926.

4 TEMPLETON, J.: "The Perennial Cultivation of Cotton, with special reference to the Cultivation of Ratoons in Egypt." *Bull.* 75, *Ministry of Agriculture*, Cairo, 1928.

[5] BROWN, C. H.: "A Preliminary Note on Some New Strains of Uppers." *Bull.* 90, *Ministry of Agriculture*, Cairo, 1929.
[6] BALLS, W. L.: *Ibid.*, p. 58.
[7] DUTT, C. P.: "Abscission in Cotton Flowers." *Botanical Gazette*, vol. 85, pp. 208-219. Chicago, 1928.
[8] TEMPLETON, J.: "The Branching of Egyptian Cotton Plants." *Bull.* 87, *Ministry of Agriculture*, Cairo, 1929.
[9] BAILEY, M.A.: "Reports from Experiment Stations, 1927-28," p. 192. EMPIRE COTTON GROWING CORPORATION. 1929.
[10] BARRITT, N. W.: *Annals of Botany*, vol. 43, No. 171. 1929.
[11] SUMMERS, F.: *Journ. Text. Institute*, 1924, 15, T543.

Received December, 1929.

A VECTOR OF LEAF CURL OF COTTON IN SOUTHERN NIGERIA

BY

F. D. GOLDING, M.A., F.E.S.

EVIDENCE has now been obtained that an—as yet unidentified—Aleurodid is capable of operating as a vector of Leaf Curl, a disease first described by Farquharson (1912),[1] on indigenous cottons (*Gossypium peruvianum* and *G. vitifolium*) in the Ishan district of Southern Nigeria.

Jones and Mason (1926)[3] have drawn attention to the striking resemblance between the histological modifications that characterize Leaf Curl and the abnormalities that accompany virus diseases, and, further, have been successful in transmitting the disease to healthy plants by budding. These writers noticed that jassids were especially abundant in May, a month in which Leaf Curl is prevalent, and it appeared probable to them that these insects might act as vectors of the disease. Some cotton plants were grown in six muslin cages, and jassids, collected from diseased plants, were introduced into three of the cages; negative results were obtained.

At Ibadan in July, 1924, the writer noticed that Aleurodid adults were very numerous on the leaves of some May-sown *peruvianum* plants, many of which were attacked by Leaf Curl. In January, 1927, seeds of the following species of Malvaceæ were sown in two cages, each 30 feet long by 16 feet wide by 8½ feet high: *Gossypium peruvianum, Hibiscus esculentus, H. sabdariffa, Urena lobata,* and *Abutilon zanzibaricum.* Within three months the majority of the cotton plants showed symptoms of Leaf Curl infection and many of the other Malvaceæ were diseased, some having enations on their leaves and others exhibiting the mottling characteristic of mosaic disease. The cages were covered with copper wire gauze with 456 perforations to the square inch; each aperture was a square with a side of about 0·06 inches in length. Apart from a number of cotton stainers, *Dysdercus superstitiosus*, F., introduced into the cages in March, the only insects present were those sufficiently small to effect an entrance through the mesh; the majority of these were Aleurodidæ. No jassids were observed to be present.

Transmission Experiments with Aleurodidæ at Ibadan.

On February 28, 1927, Mr. G. H. Jones, then a mycologist in the Nigerian Agricultural Department, sowed *peruvianum* in eight small cages with the object of determining whether insects could operate as vectors of Leaf Curl. Three sides of each cage were of muslin and the fourth of celluloid for observational purposes. The cotton seedlings were not thinned, and eventually each cage contained a stand of about ten plants. The writer advised Mr. Jones to utilize Aleurodidæ for the experiment and supplied large numbers of these insects from the two cages containing diseased Malvaceæ. The white flies were introduced into four of the cages on the following dates: Cages Nos. 2 and 4, March 23; No. 6, March 24; and No. 7, April 9 and 12. The remaining cages were used as controls.

On April 4 Mr. Jones observed one case of Leaf Curl in Cage No. 6; two days later he cut the tops off the plants in this cage; on April 19 an additional plant was found to be infected. Shortly after this date Mr. Jones proceeded on leave, and the writer continued the observational work. On May 3 one plant in Cage No. 7 showed definite signs of infection, while there were indications of Leaf Curl on a third plant in Cage No. 6. None of the plants in the control cages became diseased before the termination of the experiment on May 9.

On May 28, 1929, the writer sowed twenty stands of *peruvianum*, each being covered by a muslin cage 16 inches square by 18 inches high; on June 8 the plants were thinned to two per cage. From June 10 to 13 adult white flies were collected from infected plants on native farms and were introduced into ten of the cages through special sleeves, nine cages were retained as controls, and the remaining cage was utilized for a purpose described later.

The number of Aleurodidæ placed in the cages is shown in Table No. 1.

TABLE I.

Cage Number.	2.	4.	6.	8.	10.	12.	14.	15.	18.	20.
June 10	7	0	0	0	0	0	0	0	0	0
„ 11	0	8	8	5	0	0	0	0	0	0
„ 12	0	0	0	4	8	9	9	8	8	8
„ 13	5	4	5	3	3	7	12	12	12	12
Total number introduced ..	12	12	13	12	11	16	21	20	20	20

On July 2 Leaf Curl symptoms were seen on one leaf of a plant in Cage No. 8, and two days later the first signs of infection appeared

upon a plant in Cage No. 20. On July 6 there were indications of Leaf Curl attack on a plant in Cage No. 10, but they were not well enough defined to warrant their being considered as definite evidence of infection; the suspected plant was topped on July 22, and on August 2 was found to have produced diseased foliage.

On July 6 the tops were cut off all control and treated plants except the suspected individual in Cage No. 10; on the 22nd of that month the infected plants in Cages Nos. 8 and 20 were observed to have produced new foliage bearing net-vein enations and a few small foliar outgrowths.

On July 10 it was decided to introduce more white flies into the seven treated cages which had given negative results and into Cage No. 10. One hundred and ninety-two adult Aleurodidæ were collected from infected plants and were introduced into the eight cages on the dates shown in Table No. II.

TABLE II.

Cage Number.	2.	4.	6.	10.	12.	14.	15.	18.
July 10	7	7	7	0	7	7	7	7
„ 11	7	7	7	14	7	7	7	7
„ 12	10	10	10	10	10	10	10	10
Total number introduced ..	Twenty-four into each cage.							

On July 25 two leaves of a plant in Cage No. 2 showed slight chlorosis, the plant was topped and on August 7 was noted to have produced diseased foliage.

In Cage No. 18 a weakly plant, which had been topped on July 25, had not produced new leaves by August 2 when it became imperative to remove the cage for repair. On August 7 infected foliage was produced; the plant had been exposed for five days, but it seems unlikely that infection from some other source occurred during this period.

None of the plants in the nine control cages developed Leaf Curl.

All surviving white flies were removed from the four cages containing diseased plants, and all leaves showing signs of infection were cut off; in all cases the new foliage produced was curled.

The periods between the first introduction of white flies into cages and the appearance of Leaf Curl on the plants were as follows: Mr. Jones' 1927 experiment, 11, 24 and 24 days; the writer's 1929 experiment, 21, 22 and 24 days.

The Incidence of Aleurodidæ on Cotton.

On the completion of the cage experiments weekly counts were made of the population of adult Aleurodidæ on Ishan cotton (*G. vitifolium*) grown as a sole crop, with yams and with groundnuts; in addition weekly estimations were undertaken of the incidence of Leaf Curl.

The number of adult Aleurodidæ on the lower surfaces of fifty large leaves was utilized as the weekly index, one leaf on a plant in each of fifty consecutive ridges was examined. The minute size of the insects and the rapidity with which they take to flight on being disturbed rendered the computation of their numbers difficult, but by commencing the counts at 9 a.m., when the insects are less active, it was found possible to reverse the leaves without disturbing the white fly population on the lower surface.

The number of Aleurodidæ on fifty large leaves and the percentage of cotton plants infected by Leaf Curl are shown in Table No. III.

TABLE III.

Ishan Cotton.

Date.	*Grown Alone.*		*With Groundnuts.*		*With Yams.*	
	Number of White Flies.	*Per Cent Leaf Curl.*	*Number of White Flies.*	*Per Cent. Leaf Curl.*	*Number of White Flies.*	*Per Cent. Leaf Curl.*
1929						
August 9	39	—	77	0·5	16	—
,, 16 ..	23	—	111	0·9	10	—
,, 30 .	12	0·3	37	0·9	10	0·1
September 6 ..	10	0·3	18	1·1	0	0·1
,, 13 ..	1	0·3	4	1·3	0	0·1
,, 27 ..	2	0·3	1	1·7	3	0·1

The Ishan cotton was the Leaf Curl-resistant strain A bred out by Lewin (1927),[5] and the infection figures were small, but it will be seen that Leaf Curl was most abundant on the plot with the largest white fly population—viz., that grown with groundnuts. This crop is an alternative food plant of the Aleurodidæ.

White fly counts on Munshi cotton showed that although there were never more than eight adults on fifty leaves as many as 1·8 per cent. of the plants developed Leaf Curl by September 27.

Unfortunately no other quantitative data are available as yet, but the writer has observed white flies to be present on cotton in all months of the year except December and January. In the 1927-28

season Leaf Curl was exceptionally prevalent both at Ibadan and Ilorin (about 85 miles N.N.E.), and it was noted that there was an unusually large infestation of white flies in both localities early in the season. It is not improbable that the outbreak of Leaf Curl at Ibadan was largely due to the presence of considerable numbers of Aleurodidæ, which had been breeding from February onwards on infected Malvaceæ in the two large cages mentioned above. The cotton and other Malvaceæ in one cage were uprooted in mid-June, and in the other a few weeks after the main cotton crop was sown.

It is of interest to record that at Ibadan Ishan strain A failed to exhibit its customary resistance to Leaf Curl in the 1927-28 season. The leaves of this strain are markedly pubescent, while those of the susceptible *peruvianum* are glabrous. Ishan A is also jassid-resistant (1928),[2] probably on account of this morphological difference, and it seems not unlikely that this strain owes its usual comparative freedom from Leaf Curl to the repellent effect of its foliar pubescence upon white flies and, possibly, other insect vectors. This effect appears to be overcome in the presence of an unusual abundance of vectors. Lewin (1927)[5] has shown that while two selected strains of Ishan —viz., A and B—possess a marked resistance to Leaf Curl during the cotton season, all of the plants succumb to the disease between the onset of the rains and the end of June; he states that " the complete resistance to the disease in certain plants during the period from July to March was evidently overcome by the environmental factors which favour infection in April, May, and June." A factor which might well play an important part in the rapid dissemination of disease at this time is the uprooting of the main cotton crop and the resultant concentration of vectors upon the comparatively small areas of cotton left for observational purposes.

Frequent searches were made for white fly larvæ on a battery of sixty-five *peruvianum* plants sown in early May, but none was found before the first week of July, although adults were very numerous from early June onwards.

The principal natural enemies of Aleurodidæ are small spiders living on the lower surfaces of the leaves and an unidentified Dolichopodid fly.

Other Possible Insect Vectors of Leaf Curl.

Jassids.—It has already been stated that Jones and Mason obtained negative results in their transmission experiments with jassids. The writer introduced twenty-one adults of *Empoasca facialis*, Jac., collected from diseased plants on June 12 and 13, into

a muslin cage containing two May-sown *peruvianum* plants; there was no sign of infection four weeks later. Twenty nymphs of the same species, found on curled plants, were put in the cage on July 11; again negative results were obtained. The leaves of both plants showed a recession of chlorophyll from their margins—a typical symptom of jassid attack on native cotton.

Lean (1927),[4] working at Ilorin in the 1926-27 season, found jassids to be so abundant on one plot of unselected Ishan that the plants were dwarfed and malformed. He concluded that "since jassids were so numerous and curl very infrequent, it is now necessary to exclude jassids from the probable vectors."

The writer (1928),[2] in the same locality, in the following season noted jassids to be particularly abundant in a field where the percentage of *peruvianum* plants infected by Leaf Curl was less than ten as compared with over forty in other fields with a markedly smaller jassid population. In addition, it was observed on September 5, 1927, that white flies and curled plants were numerous in a field of Kabba cotton at Ilorin, while jassids did not become abundant until the middle of October.

It will be seen that there are indications that jassids are unlikely to be an important vector of Leaf Curl, but the writer is of the opinion that the available data are too meagre to allow of definite conclusions being made.

Aphids.—Leaf Curl transmission experiments with aphids have not yet been carried out in this country. These insects can be found on the lower surfaces of cotton leaves throughout the wet season, but usually they are numerous only in July and August, when they occur in colonies on the shoots of young plants and are attended by ants. By the end of August natural enemies—chiefly Coccinellids, Syrphid and Hemerobiid larvæ—form a very efficient control. The effect of the feeding of scattered individuals on the leaves appears to be negligible, but considerable foliar distortion results from the presence of a colony on the shoot of a young plant. Of nineteen plants heavily infested by aphid colonies on August 8, 1929, one ultimately developed Leaf Curl.

Summary.

1. Evidence has been obtained that an Aleurodid bug—as yet unidentified—can operate as a vector of Leaf Curl, a virus disease of cotton.

2. The period between the introduction of the vectors to cages containing healthy plants and the first appearance of the disease was

eleven, twenty-one, twenty-two, twenty-four, twenty-four, and twenty-four days respectively in six experiments.

3. There are indications that jassids are unlikely to be an important vector of Leaf Curl in Southern Nigeria, but more research is required.

4. The principal natural enemies of white flies are small spiders, living on the lower surfaces of cotton leaves, and an unidentified Dolichopodid fly.

ACKNOWLEDGMENT.

In conclusion the writer wishes to acknowledge his indebtedness to Mr. G. H. Jones for allowing him to utilize the data obtained in 1927.

REFERENCES.

[1] FARQUHARSON, C. O. (1912): "Report of Mycologist," *Annual Report of Agric. Dept., Nigeria*, 1912.

[2] GOLDING, F. D. (1928): "A First Survey of Insect and Fungoid Incidence on Improved Ishan Cotton." *Seventh Ann. Bull., Agric. Dept., Nigeria*, 1928.

[3] JONES, G. H., AND MASON, T. G. (1926): "On Two Obscure Diseases of Cotton." *Annals of Botany*, Vol. xl., No. clx., October, 1926.

[4] LEAN, OWEN B. (1927): "Comparative Observations on the Pests of Cotton at Ilorin, Northern Nigeria." *Sixth Ann. Bull., Agric. Dept., Nigeria*, 1927.

[5] LEWIN, C. J. (1927): "On the Incidence of Leaf Curl of Cotton in Southern Nigeria." *Ibid.*, 1927.

Received March, 1930.

ANGULAR LEAF SPOT OF COTTON IN EGYPT

THE following letter has recently been received by the Editor:

DEAR SIR,

I have recently read in the January number of the EMPIRE COTTON GROWING REVIEW an article by Tewfik Fahmy Eff. on "The Angular Leaf Spot of Cotton" in Egypt. There has also reached me vol. ii. of the Agricultural Section of the *Proceedings of the Conference of Empire Meteorologists*, 1929, in which, on pp. 32 and 33, there are references to the bacterial disease of cotton known as Black-arm in its systemic form, and Angular Leaf Spot in the localized form.

In the April, 1929, number of the E.C.G. REVIEW I gave an account of the factors leading to the production of the systemic, or Black-arm, form of the disease in cotton plants raised from seeds infected either internally or externally with *B. malvacearum* E.F.S. This was preceded by a shorter paper "On the Relation of Soil Temperature to Angular Leaf Spot of Cotton" (*Ann. Bot.*, vol. xli., no. clxiii., July, 1927), where again the source of the disease was the infected seed.

In the *Ann. Applied Biol.*, vol. xv., no. iii., August, 1928, Mr. R. H. Stoughton has given the conditions requisite for the production of the localized Angular Leaf Spot form of the disease on healthy cotton by spraying with watery suspensions of the causal organism.

Now in the Sudan, seed which has been disinfected externally by means of concentrated sulphuric acid, and internally by heating for seven days at 72° C., has produced healthy plants which, when grown under suitable conditions in the field, have subsequently contracted either Angular Leaf Spot, or Black-arm, or both, depending on environmental conditions. The necessary environmental conditions are described in the papers mentioned above.

Recent work has shown us that actual lesions on the bolls are necessary before the contents can be infected, and this usually involves a systemic infection, but in Egypt the disease runs such a mild course that this degree of infection is rarely attained. It is most probable that the light degree of infection which obtains amongst

Egyptian seed is derived from infected debris left in at picking, and from contamination during ginning.

We have found that *B. malvacearum* in debris is protected by a layer of slime, and when dry is highly resistant to environmental conditions. As an example, dried bolls bearing lesions have been heated to temperatures between 70° and 80° C. for forty-eight hours without destroying the pathogenicity of the contained parasite. Moreover, debris collected from the field after exposure to sun and wind for two months has been found to contain the organism in an active state. It is therefore suggested that Angular Leaf Spot in Egypt, and secondary infection (as distinct from the primary infection carried by the seed) in the Sudan, are both traceable to infected debris in which the causal organism has survived from the previous season.

A study of the data given in the above-mentioned papers will show that both the character of the disease and the severity of the attack are governed by definite and similar meteorological conditions both in Egypt and in the Sudan. Indeed, it seems probable that the same conditions of temperature and humidity govern the actions of the parasite wherever cotton is grown, and it is mainly with the object of eliciting the requisite information from fellow-workers in other countries that this note is written.

May I take this opportunity of correcting a sentence which appears on p. 126, l. 30 of my paper on Black-arm Disease of Cotton, printed in the E.C.G. Review, Vol. VI., No. 2, in which it is stated that external infection of the lint and fuzz is relatively rare in the Sudan. Subsequent work has shown us that external infection of the fuzz and seed is common in the Sudan, and that internal infection is confined to the type of severe infection described in the preceding lines of the same paragraph.

We are continuing our studies, and hope to summarize them at the end of the present season.

Faithfully yours,

R. E. Massey,

Govt. Botanist, Sudan Government.

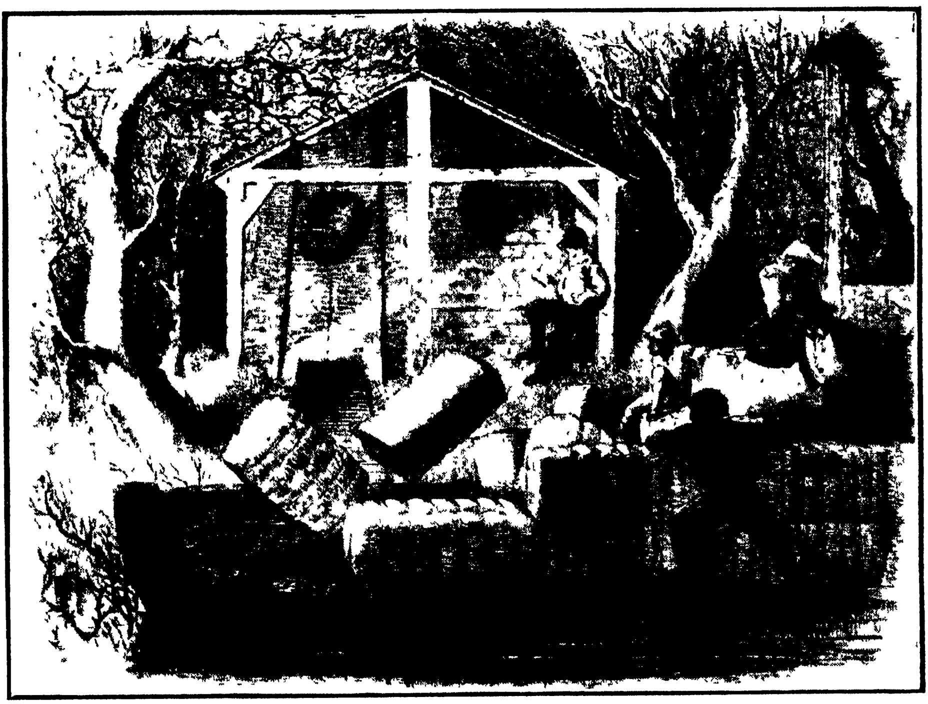
LOADING COTTON ON THE ALABAMA RIVER

The following article, copied from the *Illustrated London News* of May 4, 1861, may prove of some historic interest:

"We give this week two companion pictures illustrating the singular manner in which cotton bales are sometimes taken on board steamboats in the Alabama River in Alabama, one of the seven Southern Confederate States of America. On the Mississippi the bales are merely dragged and trundled over a plank on board ship. But on the Alabama, the banks of which are frequently high and steep, a more dashing style of embarkation is adopted. Of our two illustrations the first represents the 'shoot' *in extenso*, the other the mouth, whence the cotton-bales are projected on board the steamboat. Mr. F. Bellew, the gentleman to whom we are indebted for the illustrations, supplies the following particulars of the manner in which cotton is taken on board the steamboats that ply on the Alabama: 'It was on a dark night in February that I jumped off the top of a high bank at Montgomery on to the *Magnolia* steamboat, then lying on the turgid bosom of the Alabama River, waiting for passengers going to Mobile. There were many passengers and plenty of negroes about, but apparently no officers. The superb cabins were brilliantly lighted, and huge volumes of smoke were careering out of the double funnels. Having collected our luggage and seen an elderly clergyman break his collar-bone in attempting to leap on board, I went to bed, slept, and awoke next morning to find myself eighty miles down the river. Going on deck, I was not a little surprised to observe our vessel in the act of violating all preconceived notions of aquatic law, by going head first into a partially submerged forest, crashing and breaking through the young trees with high-pressure indifference: she was merely going to the bank to ship a few bales of cotton, which being done, she backed out and went on her way snorting, every now and then repeating the operation, like a big duck seeking food among the sedges. Sometimes the *Magnolia* would extract a feed of the staple from the most unpromising jungle; at another time an open clearing decorated with a pine-shed and a few sleepy niggers would afford a meal. But the grand

repast of our panting vessel was to come. In a certain part of the river, banked by wood-clad mountains, we suddenly slackened our speed opposite a long shed running from the water's edge to the hill's summit. The planter, in order to get his produce from the height above to the means of transport below, had constructed an extensive slide, about three hundred and fifty feet in length, and about four feet six inches wide, made of longitudinal planks, with a raised guard on each side to preserve the bales from slipping off in their descent. Parallel to the slide ran a flight of steps, the whole being covered over. Our vessel ran its nose boldly into the shore; a wide gangboard was thrown to the foot of the shoot, making a complete connection with our lower deck, where the busy hands had already constructed a species of barricade of cotton-bales to receive the shock of their coming brother bale. And now the process of loading commenced. At a given signal from below a thousand-pound package of the staple was started at the top of the slide, two hundred and fifty feet perpendicular above the level of the water. Slowly it moved at first, but, gaining momentum as it proceeded, the pace quickened —quicker, quicker, quicker—till at last it fell like a thunderbolt on the deck, knocking the bales of the barricade in every direction. In one moment a dozen black fellows were upon the new arrival, dragging it out of the way with instruments resembling boathooks, or busying themselves with reconstructing the barricade. The sable workmen having scrambled to places of safety, and the signal "All right" given, another thousand-pounder came thundering on deck, shaking our big ship from stem to stern, till every beam and rafter trembled to the uttermost end of its two hundred and fifty feet of length. The effect was absolutely terrific, and required some nerve merely to contemplate. If a man gets in the way, as sometimes happens, he is crushed like a fly under the hand of a coalheaver. However, no accident happened on the present occasion. The *Magnolia* received her fifty shocks, packed her cargo neatly round the boiler, and steamed onward.'"

Cotton-Shoot on the Alabama.



Shooting Cotton Bales into the Forepart of the River Steamer "Magnolia."

COTTON STATISTICS

WORLD'S CROPS—AMERICAN AND EGYPTIAN

BY

JOHN A. TODD, M.A., B.L.

FOLLOWING our regular schedule, we give in this issue the world's crops, with details of the American and Egyptian crops. We also repeat the diagram of the world's crops brought down to date.

The total world's supply for season 1929-30, so far as it is at present possible to estimate it, shows only a comparatively small increase from that of the previous season. 1928-29 on final revision just failed to equal the pre-war total of 1914-15 and the current season is little over that figure.

For the last four years the Indian crop has been disappointing, which has tended to check the steady increase of Outside Growths as a whole. As this question has recently been attracting a great deal of attention, the following table, which shows the relative position of American and Outside Growths in 1914 and each year since 1920, is of special interest:

AMERICAN *v.* OUTSIDE GROWTHS.

Season.	*American.**	*Others.*	*Total.*	*Others per Cent. of Total.*	*Season.*	*American.**	*Others.*	*Total.*	*Others per Cent. of Total.*
1914–15	16,992	11,117	28,109	39·5	1924–25	14,525	12,049	26,574	45·3
—	—	—	—	—	1925–26	17,219	12,582	29,801	42·2
1920–21	13,880	8,010	21,890	36·6	1926–27	19,135	11,090	30,225	36·7
1921–22	8,351	8,329	16,680	50·0	1927–28	13,972	11,938	25,910	46·1
1922–23	10,370	9,993	20,363	49·1	1928–29	15,760	12,377	28,137	44·0
1923–24	10,808	10,216	21,024	48·6	1929–30	*16,219*	*12,428*	*28,647*	*43·3*

* Including linters.

The American crop touched its lowest point in 1921 and its highest in 1926. Outside Growths touched their highest total (but not percentage) in 1925, when the Indian crop was record breaking, but as the result of the failure of the Indian crop in 1926 the *total* of the Outside Growths was back below the 1914 figure, but again not the percentage.

Since then the total has been recovering fairly steadily, but is still not quite up to the record of 1925. The recovery is largely due to the Russian crop, which is steadily rising again towards its 1915 record.

AMERICAN CROP.—Though the range of the various Government estimates throughout the season has been much larger than a year ago, that is again to the credit of the Government statisticians, because it corresponds with the changing fortunes of the crop. The August forecast was 15,543,000 bales, but in September this had to be reduced to 14,825,000 bales owing to a very severe drought in Texas and the adjoining states. The figure given in our table, 14,919,000 bales of 500 lbs., is the December estimate, but it is possible that this may have to be slightly reduced, as since October the weather has been extremely unfavourable for harvesting, and with this and the present low price it may not be worth while gathering the tag end of the crop. In spite of the failure in Texas the average yield per acre for the whole Belt is at present estimated at 155·3 lbs., as the Eastern states on the whole did fairly well, Mississippi in particular giving a surprisingly good yield.

Early in the season weevil damage looked like being very bad, but it was severely checked by the drought, though it should be noted that in South Texas, which had ample rainfall, the damage done by weevil and bollworm was probably record breaking.

EGYPTIAN CROP.—The area under cotton in Egypt this year was again increased, though not up to the record figure of 1925. So far, however, the prospects of the crop are not quite so good as the previous year. The usual table of the Egyptian crop by varieties brings out some interesting points. Sakel again showed an increase in actual acreage which just enabled it to maintain last year's percentage of the increased total, but the new varieties of Sakel type are now given separately, and, if they are added, the position of the Sakel group looks more favourable. Ashmouni and Zagora have not quite held their own on percentage, though the total is the largest on record. The most interesting comparison, however, is between the area under Ashmouni and Zagora and the total area in Upper Egypt. Though the latter is by far the largest on record there are still, it seems, nearly 200,000 feddans of Uppers varieties in the Delta, or more than there has been in any year except 1924, when the invasion first began. It is satisfactory to know that the quality of the Uppers crop is also improving.

In view of all this it is disappointing to find that the Alexandria General Produce Association's crop estimate is only 8,000,000 kantars, which on the increased acreage gives only 4·35 kantars average yield

as against 4·61 last year. Judging by the Ginning Returns to the end of January the falling off seems to be heaviest in Sakel.

Reports of the Sudan crop are rather conflicting. The Cotton Progress Report of the Central Economic Board in December showed a substantial decline from the October report for the Sakel crop, but the latest cabled report of the Department of Agriculture, which is dated December, shows a figure for Sakel much nearer the October total. We have therefore adopted the Department of Agriculture's figure in the meantime until further information is available. It shows a very substantial increase in the total crop as compared with last year.

TABLE I.—THE WORLD'S COTTON CROPS, 1902–29.

BALES OF 500 LBS. (APPROXIMATELY). 000'S OMITTED.

	America.		*Per Cent. of World Total.*	*India.**	*Egypt.*	*Russia.*	*China.*	*Others.*	*Total.*
	Lint.	*Linters.*							
1902–03	10,631	196	63	3,367	1,168	342	800	801	17,305
1903–04	9,851	195	61	3,161	1,302	477	800	751	16,537
1904–05	13,438	242	66	3,791	1,263	536	756	803	20,829
1905–06	10,575	230	61	3,416	1,192	604	788	938	17,743
1906–07	13,274	322	60	4,934	1,390	759	806	1,027	22,512
1907–08	11,107	268	62	3,122	1,447	664	875	950	18,433
1908–09	13,242	345	64	3,692	1,150	685	1,000	971	21,085
1909–10	10,005	310	54	4,719	1,000	663	1,419	950	19,066
1910–11	11,609	397	55	3,889	1,515	879	2,589	968	21,846
1911–12	15,693	558	64	3,288	1,485	873	2,552	1,058	25,507
1912–13	13,703	610	58	4,610	1,507	892	2,298	1,160	24,780
1913–14	14,156	639	57	5,066	1,537	980	2,303	1,287	25,968
1914–15	16,135	857	60	5,209	1,298	1,164	2,363	1,154	28,180
1915–16	11,192	931	57	3,738	961	1,407	2,057	984	21,270
1916–17	11,450	1,331	58	4,489	1,022	1,110	1,714	1,027	22,143
1917–18	11,302	1,126	59	4,000	1,262	603	1,863	1,086	21,242
1918–19	12,040	930	59	3,972	964	420	2,203	1,298	21,827
1919–20	11,421	608	53	5,796	1,114	274	1,914	1,484	22,611
1920–21	13,440	440	64	3,600	1,206	121	1,667	1,406	21,880
1921–22	7,954	397	51	4,485	972	57	1,263	1,310	16,438
1922–23	9,762	608	52	5,073	1,243	50	1,884	1,500	20,120
1923–24	10,140	668	52	5,161	1,306	214	1,744	1,746	20,979
1924–25	13,628	897	55	6,088	1,455	465	1,882	2,064	26,479
1925–26	16,104	1,115	58	6,215	1,593	714	1,796	2,139	29,676
1926–27	17,977	1,158	63	5,025	1,727	790	1,473	2,135	30,285
1927–28	12,956	1,016	54	5,871	1,219	925	1,812	2,051	25,850
1928–29	14,478	1,282	56	5,638	1,602	1,173	1,804	2,160	28,137
1929–30	*14,919*	*1,300*	*57*	*5,533*	*1,600*	*1,345*	*1,750*	*2,200*	*28,647*

* 400 lb. bales. Estimates in italics.

TABLE II.—AMERICAN ACREAGE, CROP, YIELD PER ACRE, AND PRICE, 1911–29.

Season.	*Acreage Harvested (000's).*	*Crop (Running Bales, 000's).*			*Average Yield (Lbs. per Acre) (Ex Linters).*	*Average Price Middling (Pence per Lb.).*
		Cotton.	*Linters.*	*Total.*		
1911–12	36,045	15,553	556	16,109	207·7	6·09
1912–13	34,283	13,489	602	14,091	190·9	6·76
1913–14	37,089	13,983	631	14,614	182·0	7·26
1914–15	36,832	15,906	832	16,738	209·2	5·22
1915–16	31,412	11,068	945	12,013	170·3	7·51
1916–17	34,985	11,364	1,300	12,664	156·6	12·33
1917–18	33,841	11,248	1,096	12,345	159·7	21·68
1918–19	36,008	11,906	910	12,817	159·6	19·73
1919–20	33,566	11,326	595	11,921	161·5	25·31
1920–21	35,878	13,271	429	13,700	178·4	11·89
1921–22	30,509	7,978	382	8,360	124·5	11·37
1922–23	33,036	9,729	591	10,320	141·5	14·92
1923–24	37,123	10,171	640	10,811	130·6	17·66
1924–25	41,360	13,639	858	14,497	157·4	13·76
1925–26	46,053	16,123	1,044	17,167	167·2	10·77
1926–27	47,087	17,755	1,042	18,977	182·6	8·15
1927–28	40,138	12,783	875	13,658	154·5	11 17
1928–29	45,341	14,297	1,086	15,382	152·9	10·52
1929–30	45,981	*14,765**	*1,100*	*15,865*	*155 3*	—

* December estimate, based on 1928 bale weights.

TABLE III.—EGYPTIAN AREA, CROP, YIELD, AND PRICE, 1914–29.

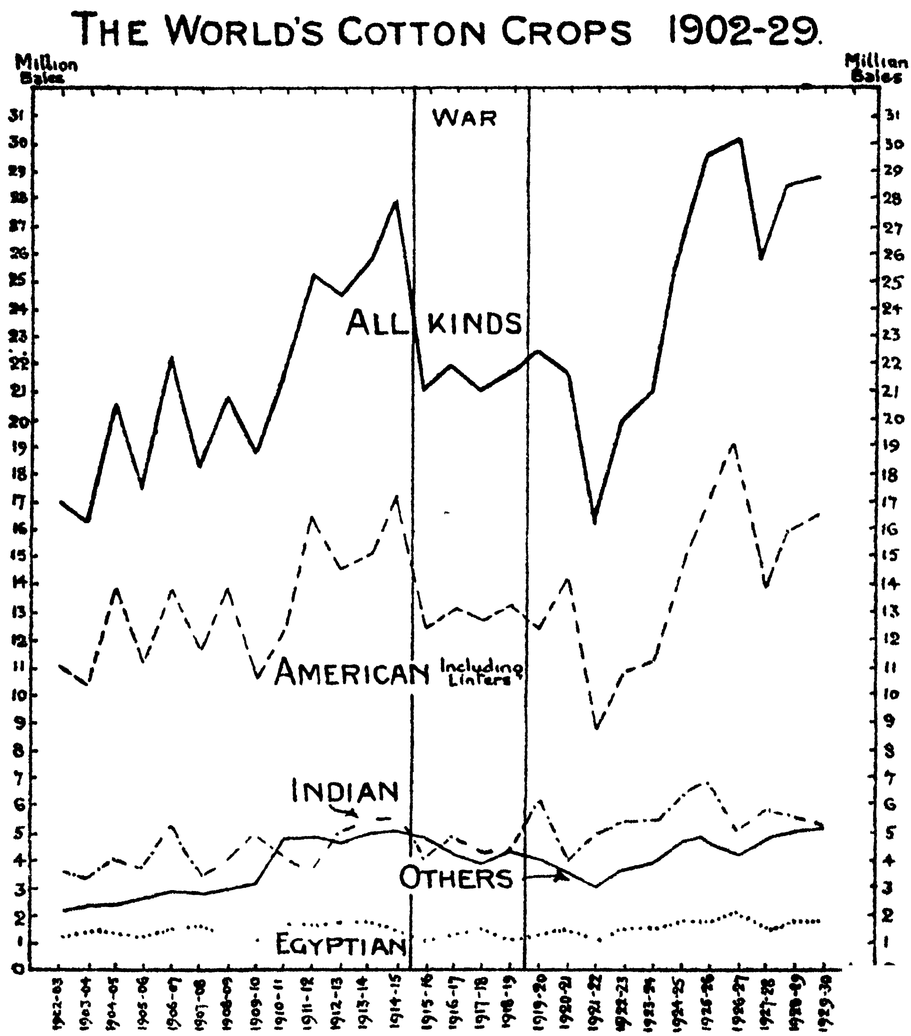
Season.	*Area. Feddans. 000's.*	*Crop. Kantars. 000's.*	*Average Yield per Feddan (Kantars).*	*Season's Average Prices.*		*Sudan Crop. Kantars 000's.*
				F. G. F. Brown. Pence per Lb.	*Premium over American Middling (per Cent.).*	
1914–15	1,755	6,490	3·70	7·34	40	95
1915–16	1,186	4,806	4·06	10·42	39	65
1916–17	1,656	5,111	3·10	21·56	75	92
				Sakel.		
1917–18	1,677	6,308	3·75	30·97	43	45
1918–19	1,316	4,821	3·66	27·85	41	64
1919–20	1,574	5,572	3·54	60·34	139	93
1920–21	1,828	6,030	3·30	30·24	154	122
1921–22	1,292	4,858	3·76	19·75	74	96
1922–23	1,801	6,213	3·45	17·29	16	113
1923–24	1,715	6,531	3·81	21·55	22	191
1924–25	1,788	7,274	4·07	29·82	117	180
1925–26	1,924	7,965	4·14	20·05	86	485
1926–27	1,786	8,635*	4·84	15·39	89	592
1927–28	1,516	6,097	4 02	19·39	74	534
1928–29	1,738	8,012	4·61	18·14	72	684
1929–30	1,841	*8,000†*	*4·35*	—	—	*837*

* The Government's final estimate was 7,652,190 kantars, the difference being the carry-over up-country.

† A. G. P. A. November estimate.

TABLE IV.—EGYPTIAN CROP: AREA BY VARIETIES.

	1914.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	1929.
Sakel	394,403	1,146,443	1,270,481	995,479	1,358,162	1,255,000	872,624	1,128,946	981,783	795,740	799,523	847,950
Per cent.	22·4	72·9	69·5	77·0	75·4	73·2	48·8	58·7	55·0	52·5	46·0	46·0
Jannovitch	127,531	97	2,087	300	225	—	—	—	—	Nahda	25,883	44,331
Per cent.	7·3	—	—	—	—						1·5	2·4
Abbassi	12,281	3,718	12,558	1,267	2,274	—	—	—	—	Maarad	—	21,548
Per cent.	0·7	0·2	0·7	0·1	0·2							1·2
Nubari	261,775	23,611	37,320	8,645	11,090	10,660	—	—	—	Fouadi	—	13,522
Per cent.	14·9	1·5	2·0	0·7	0·6	0·6						0·7
Afifi	467,350	35,145	44,068	6,771	8,202	6,050	22,271	8,384	4,234	Cazouli	—	11,397
Per cent.	26·6	2·2	2·4	0 5	0·5	0·3	1·3	0·4	0·2	4,261	—	0·6
Assili	134,104	21,003	30,051	5,839	7,863	7,820				0·3		
Per cent.	7·7	1·3	1·6	0·5	0·4	0·5						
Pilion				319	20		49,960	72,799	102,394	74,451	97,218	87,537
Per cent.				—	—		2·8	3·7	5·7	4·9	5·6	4·8
Ashmouni	353,882	334,160	283,906	170,514	276,193	310,150	796,362	270,842	667,474	599,149	768,411	419,098
Per cent.	20·2	21·3	15·5	13·2	15·3	18·1	44·5	14·1	37·4	39·5	44·2	22·8
Zagora			97,612	92,536	126,541	102.390		388,578				384,971
Per cent.			5·3	7·2	7·1	6·0		20·2				20·9
Others	3,944	9,485	49,787	10,208	10,273	23,080	46,626	54,833	29,817	42,598	47,437	11,124
Per cent.	0·2	0·6	2·7	0·8	0·5	1·3	2·6	2·8	1·7	2·8	2·7	0·6
Totals	1,755,270	1,573,662	1,827,870	1,291,878	1,800.843	1,715,150	1,787,843	1,924,382	1,785,702	1,516,199	1,738,472	1,841,478
Lower Egypt	1,373,243	1,219,303	1,378,503	1,012,349	1,378,095	1,289,520	1,264,450	1,363,318	1,248,381	1,039,236	1,143,400	1,218,152
Per cent.	78·2	77·5	75 4	78·4	76·5	75·2	70·7	70·8	69·9	68·5	65·8	66·2
Upper Egypt	382,027	354,359	449,367	279,529	422,748	425,630	523,393	561,064	537,321	31·5	595,072	623,326
Per cent.	21·8	22·5	24·6	21·6	23·5	24·8	29·3	29·2	30·1	476,963	34·2	33·8


THE WORLD'S COTTON CROPS 1902-29.
Million Bales
Million Bales
WAR
ALL KINDS
AMERICAN Including Linters
INDIAN
OTHERS
EGYPTIAN
1902-03
1903-04
1904-05
1905-06
1906-07
1907-08
1908-09
1909-10
1910-11
1911-12
1912-13
1913-14
1914-15
1915-16
1916-17
1917-18
1918-19
1919-20
1920-21
1921-22
1922-23
1923-24
1924-25
1925-26
1926-27
1927-28
1928-29
1929-30

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

156. Indian Central Cotton Committee. The twentieth meeting of the Committee, held at the Institute of Plant Industry, Indore, in November last, was the first that had been held outside Bombay. The chief matters that were discussed at the meeting were the following: The working of the Cotton Transport Act and the Cotton Ginning and Pressing Factories Act; marking of cotton bales; the question of universal and world-wide standards for Indian cottons; the effect of cotton ginning and pressing factory pools on the rates charged to the cultivator, and the possibility of controlling the erection of new factories; the finance and marketing of the cotton crop up-country; the problem of the mixing of Punjab-American and deshi cottons; the future of the Research Scholarship scheme.

At the suggestion of the Technological Research Sub-Committee, action has been taken to ensure a closer liaison between the work of the Technological Laboratory and trade requirements, and a series of trade tests, based upon definite suggestions made by trade representatives, will be undertaken at the Laboratory, and the results published for general information.

157. Indore Institute of Plant Industry. In his speech at the twentieth meeting of the Indian Central Cotton Committee, Rai Bahadur S. M. Bapna, Prime Minister of the Holkar State, said that it was now five years since the Committee decided to start a new centre of agricultural research at Indore [to the funds of which the Holkar State has been a generous contributor, ED.]. The lines upon which the Institute of Plant Industry was working were laid down by Mr. and Mrs. Howard [*Cf.* Abstr. **1**, Vol. VII.], and had at once appealed to the Central Indian States. To make practical use of the results already obtained, the Holkar Government created about two years ago a Department of Rural Development, amalgamating the Co-operative Credit movement with agricultural demonstration and seed distribution, so that there should be a single agency for dealing with the cultivators. Four new cotton markets have been started in the State, and plans for a fifth have been sanctioned for the city of Indore itself. Sir Sarupchandji Hukamchand is establishing a model seed farm for the production and distribution of the Malvi cotton that has been created at the Institute. This seed farm will be laid out, equipped and conducted on lines laid down by Mr. Howard, and will be provided with a special ginnery at which only the new variety will be handled, and it is hoped in this way to safeguard the supply of pure seed.

158. Agra and Oudh. *Cotton Cultivation.* (*Rpt. on the Agr. Stats. of the Western Circle*, 1928-29, recently received.) In comparative tests carried out at the Aligarh Experimental Farm with A. 19 cotton and various strains from Cawnpore, A. 19, and to a lesser extent C. 520, gave the best yields.

159. Bombay Cotton Annual, 1928-29, No. 10. The usual invaluable compilation of statistics relating to Crops, Prices, Exports, Imports, Stocks, Consumption, etc., necessary to everyone interested in Indian cotton.

160. Cawnpore. *Cotton Cultivation.* (*Rpt. on the Agr. Stats. of Cent. Circ., Cawnpore*, 1928-29, recently received.) Yields of cotton were good at Kalianpur. A. 19 did well; it gives the cultivator what he requires, namely, a heavy yielding variety with a high ginning percentage, which can be sown in the rains. Owing to the great demand and popularity of this cotton it has been decided to increase the area on the farm for seed production and to discontinue other varieties. A. 19 cotton also did well at other farms.

161. Madras. *Cotton Cultivation.* (*Digest* No. 85, September, 1929.) Cottonseed farms were organized in the VI. Circle, and 30 drilling setts were made and distributed for demonstration purposes.

162. A Novel Experiment Station. (*Trop. Agriculture*, vii., 1, 1930, p. 18.) Yields of crops in Madras are increasing as a result of the last twenty years' work of the Department of Agriculture, and now the supply of phosphorus and nitrogen is becoming the limiting factor. Artificial manures are cheaper, and the ryot is beginning to buy them. Owing to the wide range of manures advertised the buyers are bewildered and turn to the Agricultural Department for advice, and to meet the situation an experiment station on a novel plan is to be established. It will be subsidized by the manure firms themselves. Trials of the various manures will be conducted by the Department of Agriculture according to the latest methods, over a period of five years, when the results will be published.

163. Report on an Investigation into the Finance and Marketing of Cultivators' Cotton in the Punjab, 1927-28. Another instalment of the valuable enquiry being made into financial and marketing conditions by the Indian Central Cotton Committee. The present enquiry was carried out under the ægis of the Standing Board of Economic Enquiry (Rural Section), Punjab, which financed the work in one of the four centres selected. The investigation was conducted under the direct supervision of D. P. Johnston, Esq., I.A.S., Professor of Agriculture, Lyallpur, and the results are summarized by him.

Thirty-three villages were studied, eight in each of the districts selected, with nine in Rohtak, and 1,820 cultivators were interrogated; 48 per cent. of them were proprietors, and 78½ per cent. of the holdings averaged 25 acres in extent.

The following are the principal findings of the Report: 51·3 per cent. of the 1,820 cultivators recorded borrowed money, which was taken before or at the beginning of cultivation operations. The amount borrowed per head was Rs. 628. Credit to proprietors is more easily obtained, and the amount of debt is much higher amongst them than amongst tenants, being Rs. 818 per head as against Rs. 412 per head of tenant debtors. 68 per cent. of the sums borrowed were taken from *sowcars* (village shopkeepers), 8·8 per cent. were advanced by Co-operative Societies, 16·9 per cent. by landlords, 3 per cent. by relatives and 3 per cent. by *artis*. 67 per cent. of the loans were taken at 20 per cent. interest or less, 27 per cent. between 20 and 30 per cent., and 6 per cent. at over 30 per cent. interest. 72 per cent. of the crop was sold in the villages, 83·4 per cent. going to the village *bania* ; the rest was bought by gin-owners through commission agents. Village sales are preferred to sales in the market because of (*a*) the inconvenience of taking the produce to market; (*b*) the lack of accurate information about rates; (*c*) the suspicions aroused owing to the secret settling of rates; (*d*) the *artis* act chiefly in the interests of the buyers; and (*e*) disputes resulting in deductions are agreed to by the *arti* without the consent of the seller. There are no regulated and organized markets in the Punjab, *kapas* being sold either in the ordinary markets or in ginneries. Weighing is usually done on beam scales with correct weights, and no complaints were received regarding false weights. Market charges fluctuate between annas 13 in Sonepat and Rs. 3/8 per cent. in Lyallpur, where a ginning "pool" worked successfully in the interests of the buyers.

After consideration of the findings of the report, it was suggested that the following recommendations should be forwarded to the Government of the Punjab:

(*a*) More Co-operative Credit Societies should be formed to provide cheaper money for the growers.

(*b*) Efforts should be made to organize Co-operative Sales Societies.

(*c*) The establishment of open regulated markets based on those in Berar, with the modifications incorporated in the Bombay Cotton Markets Act, is desirable.

(*d*) The Government of the Punjab should institute an enquiry into the

effect of ginning and pressing "pools" on ginning and pressing rates, and measures should be devised to check their establishment if it is found that the grower is obtaining less for his produce in consequence.

164. Some Rotations at the Lyallpur Farm. By H. R. Stewart. (*Seasonal Notes, Punjab Agr. Dept.*, vi., **2**, 1929, p. 33.) An account of experiments carried out at Lyallpur Farm to test the power of different rotations to restore the fertility of this area, and at the same time to obtain some information as to the economics of certain intensive rotations in comparison with the common rotation of wheat, toria, cotton, under which the land had been cropped previously.

165. Introduction of Long Staple Cotton in the United Provinces: Its Past, Present, and Future. By Rama Prasada. (*Bull.* **49**, Dpt. of Agr., United Provinces, 1929.) *Summary:* Many efforts have been made in the past to grow long staple cotton, but they were mostly made by introducing foreign American and Egyptian plants. It was declared in 1872 that exotic cottons could not succeed in the climate of the United Provinces. A number of cotton strains were grown for several years from 1888, and their out-turn remained low, but when the same strains were given better cultivation, their out-turn per acre was more than doubled in 1899. Work on the improvement of local cottons was first started by Hayman. Leake studied the unit characters composing the cotton plant, and investigated the laws of their inheritance. Parr and Burt carried on work on Desi and American cottons. New strains with long staple were brought out by the writer and sent out to be tried at various centres in the hope of establishing long staple cotton through a local plant called C. 402.

The trials over a number of places with all the cotton strains suggested in the Resolution of the Provincial Cotton Committee, were carried out during the last four years. C. 402 stood out well. Its out-turn per acre was tested by growing it along with the high-yielding type prevalent in cotton areas. Its average out-turn per acre during the years 1925-26 to 1928-29 was 783 lb. at four different stations in the province. If we compare the out-turn per acre of C. 402 with the provincial average out-turn of cotton for the past ten years, which is only 333 lb. per acre, the results of C. 402 are encouraging. Moreover, if we cast a glance over all the standard cottons now grown in India we find that most of them, and specially those of high spinning qualities, do not yield much more than 500 lb. per acre.

The spinning qualities of all these cottons range from 10's to 22's. The following are the averages of the reports sent by the Bombay Technological Laboratory:

C. 1031	10–12's
C. 402	18–22's
C. 255	12's
C. 520	10–12's
Local Desi	6–8's

C. 402 is the best of the lot as regards fineness of fibre. In order to demonstrate the margin of high prices likely to be available from the superiority of the lint, the seeds of C. 402 were given to cultivators to raise large quantities of lint for getting valuation from the spinning mills. Twenty-five bales in 1927-28 were sold at Rs. 50 above per candy for Bengal rates at Bombay. In 1928-29 the same cotton was sold at Cawnpore at Rs. 340 per candy when Broach was selling at Rs. 358. If the railway freight to Bombay is added to the price obtained at Cawnpore, it exceeds in valuation even Broach cotton—the best that India produces. It is reported after examination of the lint that C. 402 can replace the Punjab-American cotton. After comparing the out-turn per acre of A. 19 and C. 402 and deducting all the charges in picking, ginning, and baling, etc., there was an increased money return of Rs. 10/6/10 per acre over and above

that obtained for A. 19 even when the produce of A. 19 was 12 per cent. higher. The superiority of lint of C. 402 makes up for the drop in out-turn per acre as compared with A. 19.

Long staple cottons generally are late-maturing plants everywhere, therefore it is necessary to irrigate the fields earlier in the season in order to extend the growing period. At present in the United Provinces short staple cottons are grown on irrigation where long staple cotton could be grown with equal success and profit to the cotton-grower. If the United Provinces Government, or the Provincial Cotton Committee, or the Department of Agriculture, can arrange for a demarcated area, and co-operation of the Irrigation Department, for C. 402 cotton cultivation in tracts where facilities for canal irrigation exist, it is believed that long staple cotton can be a success in this province. The question of marketing would require a little organization in order that cultivators should obtain the full price for their produce, and arrangements should be made for affording suitable agricultural conditions, such as good cultivation, application of manures, and a sufficient quantity of water at the sowing time, and on subsequent occasions if necessity arises.

166. Technological Reports on Standard Indian Cottons. By A. J. Turner. Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include Agricultural Details, Grader's Report, Fibre Particulars, Spinning Tests, Remarks and Conclusions.

(1) *Umri Bani*, 1929-30. Area under cultivation 225,000 acres under Government seed and 540,000 acres under cultivator's seed (mixed Gaorani). This cotton closely resembles that of previous seasons in being wasty, but it has an abnormally low fibre-weight per inch, and gives exceptionally good results for yarn strength. It is described as suitable for 22's to 28's warp.

(2) *Verum* 262, 1929-30. Area under cultivation in 1929-30 was 35,000 acres. The cotton is described as suitable for 20's to 22's warp.

167. Some Digestibility Trials on Indian Feeding-Stuffs (Pt. V.), American and Indian Cotton-Seeds. By P. E. Lander and P. L. C. Dharmani. (*Mems. of the Dpt. of Agr. in India, Chem. Ser.*, vol. x., No. 6, 1929.) The chemical analyses of American cotton-seeds 285 F., 289 F., and 4 F. (*Gossypium hirsutum*) show them to be richer in fat and protein than Desi cotton-seeds (*G. indicum*). The digestibility coefficients of the various cotton-seeds do not present sufficiently marked differences to warrant any definite distinction being made in their nutritive values, but the digestible starch equivalent and digestible protein per 100 lb. of cotton-seeds, and also the albuminoid ratio, reveal the superior value of 285 F., and to a lesser degree that of 289 F. and 4 F. American cotton-seeds. Generally the American cotton-seeds sell at a cheaper rate than Desi, therefore it pays to feed them in preference to the latter, since in addition they are also more nutritious.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

168. The following reports have recently been received:

Dpt. of Agricultural and Scientific Research. Report for the year 1928-29.

Sudan: Report of Agricultural Research Work in the Sudan, 1927-28, and Programme for 1928-29.

Swaziland: Col. Ann. Rpt., 1928.

Tanganyika: First Ann. Rpt. of the East African Agricultural Research Station, Amani, 1928-29.

West Indies *St. Vincent*: Rpt. of the Agr. Dpt. for the year 1928.

Trinidad: Imperial College of Tropical Agriculture. Principal's Report for 1928-29.

169. Reports from Experiment Stations, 1928-29. (Published by the Empire Cotton Growing Corporation, price 2s. 6d. post free.) The chief points of interest in this volume are briefly outlined in the preface, which follows the lines of that of the previous year, to which reference may with advantage be made. Its perusal should also be amplified by reading the informative summaries which, for the first time, have been provided by the authors of the various reports.

The feature of the year in regard to breeding work is the success which has attended the growth of the variety known as U.4, which was first selected by Mr. Parnell, the Corporation's plant breeder in South Africa, from a variety believed to have come originally from Uganda. This variety has done well not only in South Africa, but also in Rhodesia, where it seems likely to form the parent variety for selection. It has proved so successful in Swaziland that it is expected that no other strain will be planted in the coming season. It also appears that the variety will be suitable for Nyasaland. This is rather a wonderful record for a new plant variety, and the Corporation, and all concerned, may be congratulated upon the success attained.

Details of the breeding work with other improved strains of cotton are also included in the reports, and much good work is described dealing with crop rotations, improved methods of cultivation, the control of pests and diseases, etc.

170. ASIA: Iraq. *Agricultural Statistics for Central Iraq.* By D. D. Paterson. (*Agr. Leaflet* No. 20, Dpt. of Agr., Iraq. 1929.) In the section devoted to cotton cultivation costs an estimate is given of the cost of production of an acre of cotton at Rustam under normal conditions. Cultivation is put down at Rs. 21½, irrigation at 25½, harvesting and transport at 15. The whole cost is Rs. 75½, and it is estimated that a crop yielding 750 lb. per acre, and selling at Rs. 350 per ton of seed cotton, would pay the farmer Rs. 132 per acre, or roughly £10.

171. *Cultivation of American Cotton in Iraq.* (*Leaflet* No. 15, Dpt. of Agr., Iraq, 1927.) American cotton was first cultivated in Iraq in 1921, the variety selected for cultivation being given the commercial designation of Mesowhite. This cotton is being steadily improved from year to year. Detailed information is given as to all the operations of cultivation and harvesting, and the paper ends with a warning against spoiling the good reputation of Iraq cotton by adulteration of the American with the short-stapled local variety.

172. AFRICA: Nigeria. *Cotton Cultivation.* (*Half-yearly Rpt. of the Dept. of Agr.*, to September 30, 1929.) *Northern Provinces:* The output of American cotton from the Northern Provinces is slowly but surely recovering from the setback which it received in 1926. In the Katsina Emirate and Southern Sokoto cotton cultivation is advancing rapidly. In the latter province the output has been more than doubled for each of the last two seasons. The amount of American seed distributed has risen from 2,640 tons last season to 3,173 tons this season. It is distributed free of charge, but it is feared that much is wasted. Weather conditions were good, the rains being copious and well maintained until late in the season.

In dealing with the crop prospects for the 1929-30 season, it is stated that they were not very favourable at the beginning owing to the exceptionally heavy rainfall during September. The crop, however, made a very rapid recovery, and it is now expected that the yield will be above the average.

Southern Provinces: The outstanding feature has been the greatly increased output of Ishan cotton in the Oyo and Abeokuta Provinces, and the largely increased distribution of Ishan seed, which has actually been sold at ½d. per lb. The fact that the seed has been sold may be taken as a guarantee that it will not be wasted, and an increased output of Ishan cotton may confidently be expected. The weather in the south has not been ideal for cotton, since the rains stopped somewhat abruptly in most places.

It is gratifying to record that of the Ishan cotton purchased no less than

75 per cent. was classified as first grade, whereas of the ordinary native cotton of the Southern Provinces 98 per cent. was classified as second grade. The chief reason for this is that the growers of Ishan cotton are those who take cotton-growing seriously and are careful in the harvesting of their crop.

173. *Cotton Selection Work.* (*Bull. Imp. Inst.*, xxvii., **4**, 1929, p. 499.) The following report of the work carried out by the Botanical Section, Northern Provinces, has been furnished by the Acting Assistant Director.

"Anticipating that the indigenous varieties and the introduced American variety (Allen), now extensively grown here, might not yield any markedly superior types under pure-line selection, a number of varieties were introduced in 1928 and grown in isolated plots at Samuru. These were F. 285, F. 289, two improved strains from India; Hartsville 21, from U.S.A.; and Z. 1, U. 4, A. 12, drought-resistant strains from South Africa. None of these proved markedly superior to the Allen variety, except Hartsville 21, which gives promise of higher yield and stronger lint.

"All the varieties have been planted on isolated plots again, in 1929, along with the following new introductions: Over-the-top, Cawnpore, Cambodia, from French Sudan; Mesowhite, from Iraq; Acala from U.S.A. Single-plant selections were made from Hartsville 21, A. 12, U. 4, and Z. 1, and have been planted in progeny rows.

"'D,' a pure line selected for length of lint and ginning percentage, which has been consistently valued 20 to 40 points higher than the commercial seed, is now being multiplied in the following stages:

1. Selfed progeny (120) of single selfed plant.
2. Isolated plot, 1 acre (seed could cover 3 to 4 acres).
3. Isolated farm, 50 acres.
4. Isolated farm, 500 acres (Empire Cotton Growing Corporation).
5. Isolated area, 50,000 acres (selected farmers' land).
6. General distribution.

The ginning percentage of this strain is about 2 per cent. higher than the commercial variety, but the yield per acre is slightly lower."

174. Southern Rhodesia. *Cotton-Seed Distribution.* (*Rhod. Agr. J.*, xxvi., **11**, 1929, p. 1095.) In the November issue of the *Rhod. Agr. J.* one year ago there appeared an article on U. 4 cotton, in which it was foreshadowed that there would be sufficient seed for general distribution this year. The hopes there expressed have been fully realized, and it is satisfactory to record that sufficient U. 4 cotton seed has been produced to meet all demands, and that there is the possibility of a small surplus at the end of the planting season.

[*Cf.* Abstract **166**, vol. vi., p. 179, of this Review.]

175. South Africa. *Cotton Cultivation.* (*Farming in S. Afr.*, iv., **44**, 1929, p. 399.) "The successful breeding work carried out at the Barberton Cotton-Breeding Station by the Empire Cotton Growing Corporation has largely contributed to the spirit of optimism prevailing among the cotton-growers in the Low veld of the Transvaal, Swaziland, Natal, and Zululand. The jassid is no longer feared, as excellent yields are obtained by utilizing seed of U. 4 and Z. 1 cotton, varieties which have been developed on the Station, and which have proved to a large extent resistant to the attacks of jassid. The work at the Barberton Experiment Station, which has been greatly extended during the year, is being keenly watched. The Agricultural Department is greatly indebted to the Empire Cotton Growing Corporation for its timely assistance and guidance in this matter.

"At Rustenburg experiments have been carried out with fertilizers, crop rotations, and different varieties and strains of cotton. The breeding and selection work is progressing favourably, and seed suitable for Middle-veld conditions is being widely distributed. In the Middle-veld areas jassid is not a problem."

The report goes on to state that the most serious problem is the bollworm, against which no effective remedy has yet been devised. Research is being extended to find means of control, since until the damage done by this insect is materially reduced cotton-growing will remain an uncertain venture. If the bollworm can be overcome, then the future of the industry will be assured.

176. *Cotton Prospects.* (*Sun and Agr. J. of S. Afr.*, November, 1929, p. 1083.) In an interview given to the *Sun and Agr. J. of S. Afr.*, Mr. R. Ingram, Director and Manager of the Cotton and Tobacco Exporting Company, Ltd., said that the present cotton season has opened very well. Prospects all point to a larger acreage being put under cotton this year, and the outlook is brighter than it has been for several seasons past. This is partly due to the slump in tobacco. There is a marked improvement in cotton cultivation; farmers are giving the crop much greater personal attention, and in consequence they are getting larger yields per acre than was the case formerly.

177. *Cotton Growing in South Africa.* (*Sun and Agr. J. of S. Afr.*, October, 1929, p. 943.) In an interview given to the *Sun and Agr. J. of S. Afr.*, Mr. Milligan gave some interesting facts with regard to the work of the Corporation in the Union, work which has prevented the extinction of the cotton industry, and bids fair to enable it to grow to very appreciable proportions. He described the selection work in connection with jassid-resistant varieties, and went on to say that the new U. 4 strain was also of great value in bollworm attacks, since, although it is attacked along with other varieties, its prolific habit and quick response to any favourable change in conditions have enabled it to produce a reasonably good crop when the large bolled and slower types have been practically wiped out. In discussing crop rotation, Mr. Milligan said this question is one of universal importance in cotton-growing, and has received considerable attention at all our Stations. A wide range of possible crops have been grown during the past five years, but many of these have been rejected on account of liability to disease, insect pests, and general local unsuitability, and some time must elapse before any of the remainder could be recommended with confidence to the cotton-grower.

178. Swaziland. *Cotton Cultivation in* 1928. (*Col. Ann. Rpt.*, 1928, No. 1459, recently received.) "The cotton crop shows an improvement each year, and although the acreage under cultivation has decreased, returns are greater, due to the improved type of seed, and especially to the jassid-resistant varieties introduced by the Empire Cotton Growing Corporation. As more of the improved seed becomes available larger quantities will be grown."

179. Sudan. *Cotton Prospects.* (*Monthly Rpt. Cent. Econ. Board*, Sudan, January, 1930.) Cotton prospects in most of the Provinces are generally promising. In the Meridi district, Mongalla Province, all the cotton has been grown voluntarily by the natives, which is a definite advance. Elephants are still present in the Madi country, and have severely damaged the observation cotton plots at Kerripi. In the Tokar district, Red Sea Province, the locusts have at last all gone. Great numbers died on the Delta, and no eggs have been laid so far.

180. Agricultural Research Work in the Sudan. (Published with the consent of the London Committee for the Co-ordination of Agricultural Research in the Sudan, 1929. Obtainable from the Controller, Sudan Government Offices, Wellington House, Buckingham Gate, London, S.W.; price 2s. 6d., postage 4d.) Included in this second volume are the following reports from the various sections engaged in agricultural research in the Sudan for the season 1927-28, and programmes of work for 1928-29:

Preface. Note explaining the reasons for the investigations at the Gezira Research Farm.

Agricultural Report on the Gezira Irrigation Scheme: Season 1927-28.

Tenth Annual Report of the Gezira Research Farm: Season 1927-28.

Programme of Experiments at the Gezira Research Farm: Season 1928-29.

Report of the Botanical Section of the Gezira Research Farm, 1927-28, and Programme of Work for 1928-29.

Seed Farm Report: Season 1927-28.

Seed Farm Programme: Season 1928-29.

Report by the Director, Wellcome Tropical Research Laboratories, on Chemical and Entomological Research carried out in connection with cotton-growing in the Gezira during the season 1927-28.

Work of the Chemical Section, 1927-28.

Work of the Entomological Section, 1927-28.

Chemical and Entomological Research Programme for the Gezira: Season 1928-29.

Further investigations on Black-Arm Disease of Cotton by the Director, Wellcome Tropical Research Laboratories.

Work of the Section of Plant Physiology and Pathology, 1927-28.

Work of the Plant-Breeding Section, 1927-28.

The research work is described in great detail in the various reports, and the volume is well furnished with diagrams.

181. Tanganyika: East African Agricultural Research Station, Amani. (*First Ann. Rpt.*, 1928-29.) The report opens with the history of the Amani Institute and its various vicissitudes till it came under Mr. Nowell's control. It has always seemed a great pity that so fine a place, with such great possibilities, should go to pieces, and its rejuvenation is a subject for congratulation. The Station has been much enlarged by the addition of the Kwamkoro coffee estate of 8,000 acres, which provides more level ground for experiment. During the first year a large amount of travel over the warmer African colonies was done, with a view to devising suitable lines of work, and the Imperial Agricultural Research Conference in London was also attended.

Details are given in the report of the repairs and improvements found necessary at the Station, together with an account of the research programme to be carried out, which includes surveys, investigation of coffee problems, conservation of soil, restoration of soil fertility, plant breeding, studies of insect pests and diseases, etc.—an extensive and varied programme, the full carrying out of which would be of the greatest benefit to agricultural progress. Finally, there is a progress report on the work so far undertaken, given under the following heads: Entomology; Plant Pathology; Plant Breeding, Introduction and Distribution; Soil Science; Bio-Chemistry; Systematic Botany; Plant Physiology; Library; Plantations.

182. Togoland. *Cotton Cultivation.* (*Togoland under Br. Mandate. Col. Rpt.*, 1928. Abstr. from *Trop. Agriculture*, vi., **12**, 1929, p. 354.) "Considerable attention has been devoted to the cotton crop. Selection work has been continued, and of the many varieties tested the chief were American Upland, Webber, Sakel, Ishan, and Sonko."

183. Uganda. *Cotton Experiments.* (*Bull. Imp. Inst.*, xxvii., **4**, 1929, p. 501.) *Serere Experiment Station :* A summary is given of experimental work on cotton carried out during the 1928-29 season. The bulk increase work was mainly devoted to SG. 29, 34 acres being sown at Serere and 24 at Simsa. The seed from both plantations is being grown in the Mulondo segregated area in the coming season. About 500 acres are hoped for in this area, and this will give enough seed to plant about 7,000 acres in the 1930-31 season. In the scheme introduced by Mr. G. F. Clay, Senior Agricultural Officer, the Eastern Province is to be divided up into eight units of approximately equal acreage; the 7,000 acres following Mulondo should give ample seed to plant up one of these eight units. This is

the first up-to-date system of seed propagation, with proper control, to be tried in Uganda, and it is to be hoped that the scheme may achieve the success it deserves.

184. AUSTRALIA: QUEENSLAND. *Cotton Cultivation.* (*Queens. Agr. J.*, xxxii., 6, 1929, p. 573.) In the South Burnett district interest in cotton has been stimulated during the year by the good crops picked on departmental experiment plots, several yielding around 1,500 lb. an acre of high-quality fibre. Only moderate returns have been obtained in the Central Burnett, where, however, yields up to 1,500 lb. an acre on experimental plots are influencing a substantial extension of cotton cultivation. There was a decline in the standard of cultivation, but this may be ascribed to various factors, including the weather, that affected the year's operations. Work at the research station has been continued, and varietal tests, fertilizer trials, and cultural methods are receiving close attention.

185. *Cotton Industry.* (*Queens. Agr. J.*, xxxiii., 1, 1930, p. 2.) With a view to establishing the cotton industry more firmly in Queensland, the Minister of Agriculture and Stock, Mr. Harry F. Walker, recently announced that plans had been formulated for the cheapening of ginning costs. The question of the establishment of co-operative cotton ginneries was also about to be considered, as well as other matters relating to the stabilization and further development of cotton-growing and manufacture within the State.

186. FIJI. *Cotton Cultivation,* 1928. (*Ann. Rpt. of the Dpt. of Agr.*, 1928, recently received.) The report of Mr. Anson, the Cotton Specialist, describes the selection work with Sea Island and New Guinea Kidney cottons, varietal tests with Sea Island, Kidney Hybrids, Sakel, Tanguis and Meade cottons, time of flowering, and spacing and crossing experiments. The chief pests and diseases encountered during the year were: Pink bollworm, jassid, cotton stainers, Harlequin bug, fruit fly (*Dacus passifloræ*), tip worm, and black-arm disease.

Mr. Anson writes that although the two past seasons have proved very discouraging, the prospects for the future development of the industry appear to be much brighter, and native growers are quite keen to obtain seed of the new Kidney variety.

187. WEST INDIES: ST. VINCENT. *Cotton Cultivation.* (*Rpt. on the Agr. Dpt.*, 1928, recently received.) The area under cotton for the season 1928-29 amounted to 4,381 acres, of which 3,386 were under Sea Island and 995 under Marie Galante. It was considered that the yield of cotton would be poor owing to attacks of Cotton Worm (*Alabama argillacea*) and the incidence of soft rot (*Phytophthora*). Other pests and diseases causing injury during the season under review were: Pink bollworm, cotton stainer, bronze beetle, black scale, white scale, the fungus *Sclerotium rolfsii* (causing "damping-off" disease), and West Indian mildew.

In manurial experiments carried out at the Experiment Station it was found that pen manure, at the rate of 10 tons to the acre, gave an increase over seven years of 38 per cent., and green dressing and potash gave 45 per cent.

An account is included in the report of the working of the cotton ginnery. The total quantity of seed cotton received for ginning was only 56·8 per cent. of the previous season's receipts, this being due to the considerable reduction in acreage and to the fact that the weather conditions were unfavourable. A Simon's Patent Heater was installed for use in the treatment of cotton seed for the destruction of pink bollworm, and proved quite satisfactory.

188. *Cotton Prospects.* From a report recently received we learn that the total area planted to cotton for the 1929-30 season was approximately 1,700 acres. The appearance of the crop as a whole is encouraging, and planters generally are satisfied with the prospects. Reports from the Southern Grenadines show that the Marie Galante cotton crop promises to be good.

COTTON IN THE UNITED STATES.

189. THE PRODUCTION OF COTTON. (*Science Supplement*, lxx., 1821, 1929, p. x.) " 'Cotton is still king in the Southland, but his throne is a bit uneasy under him, and in the course of a few years he may have to share domain with younger King Cottons who are growing up in other lands.' This is the gist of a prophetic report to *Economic Geography* by Professor Earl C. Case, of the University of Cincinnati.

"The very factors that helped to establish the southern part of the United States as the leading cotton-producing area in the world are now helping in its decline, and in the rise of rival cotton regions. Our cotton belt is a compact block of fertile soil with a climate well suited to cotton growing. But the fertility of the soil is declining, and the climate has been as favourable to the enemies of cotton—boll weevil and the rest—as it was to the cotton itself. Bad years affect the whole area and may cut down the yield 50 per cent., because it is all in one piece; whereas cotton lands elsewhere in the world, being cut up into smaller and scattered blocks, escape in most parts when disaster visits any particular point.

"Another important factor that is threatening the supremacy of American cotton is the rise in the cost of cotton-farming labour in this country. Even though the negro and 'poor white' labour of the South is among the worst-rewarded of all American agricultural work, its wage is still many times higher than that of cotton-field workers in South America, India, Egypt, the Sudan and China. And the northward migration of negroes that has been going on ever since the new immigration laws cut down the supply of unskilled labourers in northern industrial plants is seriously cutting into the rural population of the South.

"The apparent determination of British cotton spinners and weavers to reduce the degree of their dependence on American cotton by increasing the quantities of the fibre grown 'within the Empire,' is another influencing factor. Great new cotton areas have been opened up within the past few years in India, in the Sudan and in Tanganyika; and the cotton-fields of Egypt still have strong British connections in spite of the changed political status of that nation. South American nations, notably Brazil and Argentina, are making strong efforts to become at least partly self-dependent.

"China, one of the greatest cotton markets of the world, now raises a great deal of low-grade cotton. Professor Case believes that the Chinese farmers, though the world's most obstinate conservatives, may in time be persuaded to introduce improved varieties and to adopt improved cultivation methods. If and when that happens, China will need a great deal less foreign cotton."

190. AMERICAN COTTON. (*Sunday Times*, 15-12-29.) In his testimony before the Senate Committee which is investigating the causes existing for the low price of cotton, Mr. Clayton (of Anderson, Clayton & Co., Houston, Texas) expressed the opinion that the growing competition of foreign cotton, and the steady deterioration in the quality of American compared with better and improving staple in other countries, are the underlying causes of the low prices. He stated that unless the Government plans to give the grower a subsidy, the only hope of rendering the producer able to enjoy a decent standard of living lies in improved methods of production of a better cotton from a smaller acreage.

191. AMERICAN COTTON: PRODUCTION. By G. W. Fooshe. (*M/c. Guar. Coml.*, 20, 11, 1930. Abstr. from *Summ. of Curr. Lit.*, x., 2, 1930, p. 23.) A Government enquiry has revealed the fact that the low price of American cotton is due to competition. America is losing ground in both quantity and quality of production, compared with India, Brazil, Peru, Russia, Egypt, and some other

countries that grow cotton on a large scale. More than 20 per cent. of the crop produced in the United States in 1929 was shorter than $\frac{7}{8}$ in., whereas a few years ago such staple was practically unknown. India, China, Brazil, Peru, and other foreign countries, on the other hand, are moving in the opposite direction and improving the quality of their output from year to year. America is still producing more than 50 per cent. of the cotton grown in the world each year, and therefore still dominates the price of the staple, but the margin of leadership is being gradually cut down. The unfortunate plight of American cotton growers as a class is due as much to decreased yield as to declining quality. The extent of the decrease is more than 15 per cent. in the last decade.

192. A BITTER PILL FOR AMERICAN COTTON: LOWER ACREAGE REMEDY FOR FALLING QUALITY. By G. W. Fooshe. (*Coml. Ann. Rev.*, 30-1-30.) The author is of opinion that reduction of acreage, with all the betterment in land selection, in cultivation, in fertilization, and in weevil control, that it would make possible, would ensure increased yield per acre and decided improvement in the spinning value of the crop. The position of individual growers would be distinctly improved, and that of America as a source of really desirable cotton would be materially strengthened.

193. COTTON STANDARDS. (*U.S. Dpt. Agr. Serv. and Regulatory Announcements*, No. 117, 1929. Abstr. from *Summ. of Curr. Lit.*, x., 2, 1930, p. 31.) The proceedings of the International Universal Cotton Standards Conference of 1929 are recorded, and items relating to the administration of the United States Cotton Futures and Cotton Standards Acts are discussed.

194. MARKETING OF COTTON. By Dr. C. B. Warner. (*Int. Cot. Bull.*, viii., 30, 1930, p. 301.) Extracts from an article in the *Manufacturers' Record*, describing a plan for improving the marketing of American cotton and cotton textiles.

195. THE CO-ORDINATION OF COTTON RESEARCH IN THE UNITED STATES OF AMERICA. By W. J. Jenkins. (*Agr. Jour. India*, xxiv., 6, 1929, p. 428.) The *Official Record*, No. 25, 1929, of the U.S. Department of Agriculture contains an interesting account of the steps taken by the Department to co-ordinate and develop all branches of its research work bearing upon the growth, marketing, and manufacture of cotton. A special Committee of experts has been set up with the object of unifying and intensifying the attack on all cotton problems in the States from the seed to the consumer. The chief duties of this Committee will be to examine, report upon, and make recommendations with regard to all the cotton research projects of the Department, with special reference to the effectiveness and adequacy of work under way and its modification or expansion in the future. The Committee will have no administrative functions other than those conferred upon it by the Department, but it is felt that such a body will be able to exercise a most beneficial influence in unifying the programme of cotton research. In addition, it is anticipated that the Committee will prove to be of great value in co-ordinating research work on the one hand, with extension work—*e.g.*, marketing, distribution, and consumption—on the other, both from a Federal and a State standpoint.

196. COTTON CULTIVATION IN CALIFORNIA. (*Southern California Crops*, v., 12, 1929.) " This is the first season that most of the San Joaquin Valley was planted with good seed. One Acala plant selected in 1924 has increased so rapidly that at least 75 per cent. of the entire valley was planted with seed from this origin this year. This almost unbelievable accomplishment was brought about through the assistance of the Farm Bureau Cotton Seed Distributors in Bakersfield. Never before, in any part of the cotton world, has the progeny of one

plant been so quickly and so widely made use of by the growers to the exclusion of everything else."

Report vi., No. 1, recently received, states that an increase in cotton production is expected for the present year, but labour shortage is anticipated.

197. COTTON EXPERIMENTS IN MISSISSIPPI. (i.) *Rpt. South. Miss. Expt. Sta.*, 1928. Contains a description of variety tests and numerous experiments with different fertilizers on cotton; also field experiments with cereals and other crops, such as alfalfa, soy beans, and sugar-cane.

(ii.) *Rpt. Holly Springs Expt. Sta.*, 1928. Contains instructions and advice to farmers on cotton cultivation, best time of planting, weevil control, and other pests and diseases. Variety tests and fertilizer experiments are described.

(iii.) *Rpt. Raymond Expt. Sta.*, 1928. A description of variety tests and various field experiments on cotton and cereals.

COTTON IN EGYPT.

198. EGYPTIAN COTTON YIELD INCREASING. (*Man. Guar. Coml.*, January 30, 1930.) The author of this article states that almost from the beginning of the century, as soon as a fall in Egyptian cotton yields was noticed, the reasons for it received intensive study and caused considerable discussion. The fall, however, went on unchecked till about 1918, but then the tide turned, and the yield rose at almost exactly the same rate as it had previously been falling. The present yields of 4¼ to 4½ kantars per acre compare extremely well with American yields, which seem quite unable to rise above an average of 150 to 170 lb. The author considers that the present rise of the average is due mainly to the continued extension of the cotton area in Upper Egypt. Improvements in drainage and in methods of cultivation and the use of improved varieties are also helping.

199. MAARAD COTTON SEED. (*Ind. Text. J.*, October 31, 1929.) Gives the regulations as to ginning and sale of Maarad cotton seed, issued by the Royal Agricultural Society of Egypt.

200. HOW TO USE MAARAD COTTON: ACTUAL EXPERIENCE OF A CONTINENTAL SPINNING MILL. (*Int. Cot. Bull.*, viii., **30**, 1930, p. 330.) In order to test the suitability of Maarad cotton from the point of view of its taking the place of Sakellaridis, considering the continually growing depreciation of this latter variety, a Continental spinning mill made trials with two bales of Maarad cotton. The bales were tested for staple, regularity, cleanness, waste in the blowing-room and in the carding process, and spinning qualities. From the results obtained so far, the opinion is expressed that Maarad cotton is qualified to replace the present-day Sakellaridis, if not to surpass it.

COTTON IN FOREIGN COUNTRIES.

201. ASSOCIATION COTONNIÈRE COLONIALE. We have received a copy of *Bull.* No. 89, 1930, containing information on cotton in the Ivory Coast, Morocco, Tunis, New Caledonia, and other French Colonies.

202. ARGENTINE. *Cotton Cultivation.* (*Int. Cot. Bull.*, viii., **30**, 1930, p. 273.) Statistics of production are given. There has been a falling off since 1926, but a recovery is now anticipated. Farmers have started the vicious practice of damping the cotton for the purpose of gaining weight. A movement is on foot to increase tariffs on all imported manufactured cotton goods, with a view to forcing spinners and manufacturers to establish themselves in the country and to use Argentine cotton on the spot.

203. BELGIAN CONGO. *Cotton Cultivation.* By J. Tilmant. (*Rev. Text.*, **27**, 1391, 1929. Abstr. from *Sum. of Curr. Lit.*, ix., **21**, 1929, E. 31.) A discussion of difficulties due to taxation, regulations in regard to ginning, and to inefficient and expensive means of transport, which have led to the decline of cotton-growing in the Belgian Congo.

204. BRAZIL. *Relatorio da Delegaçia do Serviço Federal do Algodão na Parahyba em* 1928 (Report of the Delegation of the Federal Service on Cotton in Parahyba, 1928). By F. L. Alves Costa. From this profusely illustrated report (in Portuguese) we learn that owing to the bad season the cotton crop was poor except in the dry districts, where better results were obtained, especially with the good seed distributed in the last five years. The cultivator is learning the value of good seed, and this is a step in advance; he is also realizing the benefits due to classification of cottons, co-operation, etc. A fight against pink bollworm is going on, and other work is being done for the improvement of the cotton situation. Maarad cotton gives promise of being a useful variety. Cost of production on the station was found to be about 1 milrei (6d.) per kilo (2¼ lb.) of lint. The report is a record of useful work.

205. COTTON CULTIVATION IN BULGARIA. (*Rev. Text.*, 1929, **27**, 1245. Abstr. from *J. of Text. Inst.*, xx., **12**, 1929, A. 633.) The production of cotton in Bulgaria has risen from 243 tons in 1921 to 949 tons in 1927. The yield varies from 120 to 173 kg. per hectare. Bulgarian cotton is a better white than American cotton, and its elasticity is good. The spinning concerns in the country are few in number, and the weaving is carried out chiefly in the homes of the people.

206. CHINA: THE HUA SING COTTON MILL OF TIENTSIN. (*Int. Cot. Bull.*, viii., **30**, 1930, p. 379.) Deals with the internal organization of the mill, care of the operatives, equipment of the various departments, daily output.

207. PERU. *Cotton Cultivation.* (*Int. Cot. Bull.*, viii., **30**, 1930, p. 274.) According to the National Agricultural Society of Peru, the total cotton acreage this season is estimated at 115,000 hectares, with a production of 210,000 bales.

208. COTTON CULTIVATION IN TURKEY (ADANA). By A. Marcus. (*Biol. Abs.*, **3**, 1929, 244. Abstr. from *Summ. of Curr. Lit.*, ix., **21**, 1929, E. 31.) Cotton is the most important crop in Adana. Varieties of *Gossypium herbaceum* and *G. hirsutum* are mainly grown, using a two-crop rotation of cotton and cereals (wheat and barley). Seed is broadcast. Soil and climate are described. There is an experiment station.

209. THE COTTON TRUST OF CENTRAL ASIA. By A. L. Strong. (*Text. Rec.*, xlvii., **562**, 1930, p. 23.) A general account of the Cotton Trust, one of the largest and most unusual cotton-growing organizations in the world, which appears to have done wonders in resuscitating the cotton industry in Central Asia.

210. A NEW COTTON INDUSTRY. (*Int. Cot. Bull.*, viii., **30**, 1930, p. 378.) A new cotton-spinning and weaving mill has recently been completed at Ashkhbad, Turkmenistan (Central Asia). It contains 10,000 spindles and 350 Northrop looms, all manufactured at Soviet works. About 600 workers are now employed.

SOILS AND MANURES.

211. A HANDBOOK OF SOIL SCIENCE—I. Edited by E. Blanck. (*Handbuch der Bodenlehre.* Berlin: Julius Springer, 1929. Abstr. from *Exp. Sta. Rec.*, 61, **6**, 1929, p. 503.) A general textbook of the scientific study of the soil is intended, the nature of the first volume, here noted, being indicated by the main subdivisions of its contents. These are as follows: An introduction, comprising chapters on

the study of the soil as a science and on the historical aspects of the development of soil science up to the beginning of the twentieth century; and Part I., the general or scientific study of the soil, under which are included the parent material and the natural science fundamentals of the study of the processes of soil formation, with numerous subdivisions of this last-named subject.

212. THE ULTIMATE STRUCTURE OF SOILS. By G. J. Bouyoucos. (*Soil Sci.*, xxviii., **1**, Baltimore, 1929. Abstr. from *Int. Rev. of Agr.*, xx., **10**, 1929, p. 397.) The author considers that the ultimate soil structure cannot be determined in the field, but requires a mechanical analysis by decantation in a large quantity of water with, for example, a hydrometer. The study of certain physical properties of soil, such as penetration, infiltration of water, etc., must be based on knowledge of this ultimate texture.

213. THE SO-CALLED "BUILD-UP" AND "BREAK-DOWN" OF SOIL ZEOLITES AS INFLUENCED BY REACTION. By P. S. Burgess. (*Bull.* 28, Univ. of Ariz. Agr. Exp. Sta., 1929.) This bulletin presents certain data which have been secured during the past two years on the disintegration and "build-up" of those hydrated aluminum silicates which possess the property of base-exchange and which, for want of a better term, are called zeolites. Natural soil zeolites as well as synthetic zeolites have been used in these studies. A review of the more important literature bearing upon the subject has been made.

214. COTTON PLANT: FERTILIZER REQUIREMENTS. By G. Chevalier. (*Chem. Abs.*, 1929, **23**, 4522 [from *Ann. Sci. Agron.*, 1929, **46**, 320-330]. Abstr. from *Summ. of Curr. Lit.*, ix., **21**, 1929, E. 31.) Nitrogen is rapidly absorbed in the early stages of growth, decreasing with increasing maturity. About 40 kg. of soluble nitrogen, equivalent to 200 kg. of ammonium nitrate or 250 kg. of ammonium sulphate per hectare, are required. Phosphoric acid is absorbed rapidly at first, and then slowly and continuously to the end of growth. The potassium absorption is high at the beginning of growth, declines towards the flowering stage, and then increases again.

215. EFFECTS OF SYNTHETIC NITROGEN AND CONCENTRATED FERTILIZERS ON COTTON AND SWEET POTATOES. By J. J. Skinner *et al.* (*North Carolina Sta. Bull.* 266, 1929. Abstr. from *Exp. Sta. Rec.*, 61, **7**, 1929, p. 622.) Descriptions of sixteen of the newer nitrogenous fertilizers and of tests carried out with them. The results obtained with concentrated fertilizers were not as good as those with ordinary commercial fertilizers. It appeared desirable to use synthetic and other mineral nitrogenous salts in conjunction with organic sources of nitrogen.

[*Cf.* Abstract **580**, vol. vi., p. 361.]

216. COTTON FERTILIZER EXPERIMENTS IN THE SALT RIVER VALLEY. By G. H. Serviss and R. S. Hawkins. (*Bull.* 129, Univ. of Ariz. Agr. Exp. Sta., 1929.) The use of ammonium sulphate on sandy soils of the Salt River Valley usually resulted in an increased yield, but not necessarily a profit. Phosphorus alone was not profitable, and phosphorus in combination with other fertilizers was only profitable in a few instances. The addition of potash was unprofitable in all cases.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

217. COMPOSITION AND ECONOMIC POSSIBILITIES OF THE COTTON BUR. By K. S. Markley. (*J. Amer. Soc. Agr.*, xx., **10**, 1928. Abstr. from *Exp. Sta. Rec.*, 60, **4**, 1928, p. 328.) Analyses of cotton burs produced in Oklahoma in the harvesting of cotton by snapping or sledding showed that without hydrolytic treatment they do not have a high feeding value for cattle, and they are not worth much as a source of furfural. While the pentosan content is quite low, their cellulose content

might possibly make them valuable as a source of pulp for paper or rayon. The large quantities of mineral nutrients removed from the soil, evident from the ash analysis, should be replaced either by fertilizer application or by returning the burs to the soil either in the form of ash, whole burs, or preferably by the artificially decomposed burs.

218. Mechanical Cotton Pickers and Harvesters. (*Int. Cot. Bull.*, viii., 30, 1930, p. 292.) Two mechanical cotton pickers have made their appearance in the cotton fields of the United States this season.

The *Durant Cotton Picker*, made by the manufacturers of the Durant motor-car, is a small light machine 2 ft. wide and 5½ ft. long, weighing about 300 lb. It carries a bag to hold 100 lb. of seed cotton, and is pushed between the cotton rows by the two men operating the two nozzles. The nozzle is simply held against the boll to be picked; each picker-head contains a pair of revolving aluminium rollers, which pick the cotton from the boll, just as any hand-picker would do, and pass the picked seed cotton to a flexible tube through which a current of air draws the boll to the sack. Before being deposited in the sack the boll is thrown against a metal screen, which separates dirt and sand from the cotton. The makers claim that the current of air also removes moisture from the lint, and for this reason the cotton-picker may be used when dew is still on the plants, when hand picking should not be carried on. A small single cylinder petrol engine of about 1 h.p. revolves the fan which creates the current of air; this engine consumes approximately one gallon of petrol in a day. The manufacturers claim that the machine picks the cotton more cleanly than by hand, and that consequently the grade is improved. During tests carried out at Corpus Christi, cotton picked by this method graded strict middling; moreover, the colour was improved. The actual saving in the cost of picking and the increase in the selling price of the better-graded cotton amounted to $10.20 per bale.

The writer considers that one drawback the machine has at present is that it fluffs out the bolls, and in many cases separates the different locks. According to a gin manufacturer, these separate locks will cause the lint to be gin-cut when it passes through the gins. This statement was supported by the samples of hand-picked and machine-picked ginned cotton shown by the manufacturer of the picker. Although the machine-picked cotton was much cleaner than the hand-picked, the former was very roughly ginned and full of neps, whereas the hand-picked cotton, picked on the same day, was smoothly ginned cotton.

The *Smith-Conrad* "*Combine*" cotton harvester, manufactured by the General Cotton Harvester Co., Fort Worth, Texas, is a cotton stripper, cleaner, and huller combined. The single-row machine will harvest 5 to 7 acres a day, while a two-row machine is able to harvest double that capacity. Compared with hand-picking, it is said that the machine is capable of doing the work of ten men. The machine has the appearance of a "sled," and, in fact, it is a sled, but the open cotton is picked separately and deposited in one receptacle, while the "bollies" pass on to the hull extractor which separates the lint from the hulls. By this means the "bollies" are kept separate from the mature fibre. It is intended to pass this machine through the fields after the first pickings have been taken off.

DISEASES, PESTS, AND INJURIES, AND THEIR CONTROL.

219. Methoden zur Prüfung von Pflanzschutzmitteln. II. Mitteilung: Die Bestimmung der Haftfähigkeit von Staubemitteln. (Methods for Testing Materials for Plant Protection. 2nd Communication: The Determination of the Adhesiveness of Dusts.) By H. Voelkel. (*Arb. Biol. Reichsanst.*, xvii., No. 3, Berlin, 1929. Abstr. from *Rev. App. Ent.*, xvii.,

Ser. A., 11, 1929, p. 640.) A general discussion of the subject with results of tests upon seventy-eight powders.

220. Multiple Parasitism: Its Relation to the Control of Insect Pests. By H. S. Smith. (*Bull. Ent. Res.*, xx. 2, 1929, p. 141. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, 11, 1929, p. 653.) The term "multiple parasitism" has been suggested by the author to designate that type of parasitism in which the same individual host insect is inhabited simultaneously by the young of two or more different species of primary parasites. In the case of solitary parasites, such competition generally results in the death of one or the other parasite. Often, because of specific fitness, one species is always dominant when two meet in competition.

In the practical work of introducing entomophagous insects into new habitats to aid in the control of insect pests, this condition is often encountered, and it is maintained by some entomologists, as for example, Pemberton, Willard, and Bissell, that such competition results in a lower mortality of the host than would occur if a single species were present. Since the usual practice is to introduce all available primary parasites, the point is very important.

The characteristics of parasites in relation to competition within the host are designated as intrinsic. When the survival of parasites living in the same host is not determined by their specific peculiarities (such as length and strength of mandibles, aggressiveness, etc.) but simply by chance (as, for example, the moment of arrival in the host), parasites are said to be intrinsically equal; otherwise one species is intrinsically superior and the other intrinsically inferior. The characteristics of parasites in relation to the environment are designated as extrinsic. Two species of parasites occupying the same number of "ecological niches" are extrinsically equal. If one species occupies a larger number of ecological niches than another, it is extrinsically superior and its competitor extrinsically inferior.

Under this classification, various types of multiple parasitism may exist. The competing species may be both intrinsically and extrinsically equal, equal in either one of these respects but unequal in the other, or unequal in both. In the last case the species that is intrinsically superior may be either superior or inferior extrinsically. All these types of multiple parasitism are discussed by the author, who maintains that in no case is it disadvantageous to import both of the competing species, while in the majority of cases it is positively advantageous to do so. He does not consider that the data put forward by Pemberton, Willard, and Bissell constitute sufficient proof of their contention that *Opius humilis*, Silv., which is extrinsically superior, but intrinsically inferior to *Diachasma tryoni*, Cam., would have accomplished more alone in controlling the Mediterranean fruit-fly (*Ceratitis capitata*, Wied.) in Hawaii than in conjunction with the latter parasite. He believes that, on theoretical grounds as well as on the data so far available, the policy of introducing all available primary parasites of injurious insects is justified, especially since sudden environmental changes, which might be detrimental to any one species, are not likely to affect all of a group of species in the same way.

[*Cf.* Abstract 257, below.]

221. Collective Review of Relations between Host Plant and Parasites, III. (Trans. title.) By A. Zimmermann. (*Centl. Bakt.* [etc.], 2, Abt. 69 (1927), No. 15-24, pp. 352-425; 70 (1927), Nos. 1-7, pp. 51-86; 8-14, pp. 261-313; 15-24, pp. 411-436. Abstr. from *Exp. Sta. Rec.*, lxi., 6, 1929, p. 532.) This series, now completed, represents the author's attempt to present for the use of German students of phytopathology a comprehensive and compact, though critically selective, account of what is known regarding the relations and processes involving plants and parasites causing plant diseases. This third part deals with Sclerotinia, Monilia, and Botrytis.

222. THE EFFECT OF SOME POISONS ON THE CHIEF PESTS OF COTTON IN CENTRAL ASIA. (In Russian.) By P. Galakhov. (*Khlop. Delo*, viii., **5-6**, Moscow, 1929. Abstr. from *Rev. App. Ent.*, Ser. A, Pt. 11, 1929, p. 631.) In experiments against *Tetranychus sp.*, dusting with sublimed flowers of sulphur (45 lb. to the acre) killed 90 per cent.; spraying with soap at the rate of 1 lb. to 12½ pints water killed 71-86 per cent., and with wheat flour at the same rate over 62 per cent. Against *Aphis gossypii*, Glov., best results were obtained with soap sprays containing a large percentage of fatty animal acids, and applications at the rate of 1 lb. to 25 pints water killed 90 per cent. The preparations used had no effect on the cotton. The temperature at which the experiments were carried out was about 78° F. and the relative humidity 98 per cent.

223. CONTRIBUTION TO THE QUESTION OF THE CONTROL OF THE CHIEF PESTS OF COTTON. By V. Plotnikov. (In Russian.) (*Khlop. Delo.*, viii., **5-6**, pp. 579-84. Moscow, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, **11**, 1929, p. 631.) A review of the chief pests of cotton in Central Asia observed by the author in 1925-28. The relation between the infestation of cotton by these pests and temperature conditions is discussed. Thrips are particularly abundant when the development of the plants is retarded and their resistance to infestation decreased by low temperatures, whereas *Tetranychus telarius*, L. (*Epitetranychus althææ*, v. Hanst.), is prevalent in hot summers, and *Aphis gossypii*, Glov., in warm and protracted autumns. It is possible that more than one species of thrips is responsible for the damage done to the cotton, but the one observed by the author was *Thrips tabaci*, Lind. Young plants suffer severely from its attacks, but may easily recover from them, the slightest improvement in the nutritive elements of the soil considerably raising their power of resistance. The author therefore recommends improved cultivation of the cotton rather than direct control of the thrips.

Infestation by *Tetranychus telarius* greatly weakens the plants, but experiments, the results of which are given, show that some varieties are more resistant than others, and that chemical manures considerably increase the crop. The best means of protecting cotton from infestation would therefore be to cultivate resistant varieties and improve the manuring, as the rapid reproduction of the mite makes direct measures against it comparatively ineffective. When, however, proper cultivation has been neglected, dusting with flowers of sulphur is recommended; applied at the rate of about 32 lb. to the acre it kills about 50 per cent. of the mites, while at 320 lb. it effects complete control. The best time for dusting is before 9 a.m. and after 5 p.m.

In order to prevent the migration of *Aphis gossypii* to cotton from adjoining fields of cucurbits, the latter should be sprayed with soap solution or nicotine and soap, or preferably dusted with nicotine and freshly slaked lime.

224. QUADRO SYNOPTICO E PRATICO DA PHYTOPATHOLOGIA BRASILEIRA. By J. de Campos Novaes. (*Chacaras e Quintaes*, xxxv., **5**, S. Paulo, 1927-29. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **1**, 1930, p. 13.) This is an annotated list of two hundred diseases and pests of economic plants in Brazil, giving the scientific name and systematic position of the injurious organism, and indicating the manner in which the plant is attacked and the remedies advised. Formulæ for insecticides and fungicides are appended.

225. DILUTED CALCIUM ARSENATE FOR BOLL WEEVIL CONTROL. By E. F. Grossman. (*Jnl. of Econ. Ent.*, xxii., **6**, 1929, p. 972.) Experiments extending over three years led to the conclusion that a diluted mixture, 50-50 calcium arsenate and hydrated lime, when well mixed and distributed, will control the boll weevil as well as the undiluted calcium arsenate, and in addition, the cost of the diluted mixture is materially less.

226. RESUMPTION OF EGG-LAYING BY HIBERNATED COTTON BOLL WEEVILS (*Anthonomus grandis*, Boh.). By E. F. Grossman. (*Fla. Ent.*, **12**, 3, Gainesville, Fla, 1928. Abstr. from *Exp. Sta. Rec.*, lxi., **6**, 1929, p. 556.) Earlier work having indicated that the boll weevil must feed on squares before it can lay eggs, the author was led to conduct the further experiments at the Florida Experiment Station here reported. In two instances eggs were laid within twenty-four hours following a leaf diet. He concludes that if the presence of a vitamin is necessary for the oviposition of eggs it must be present in the terminal leaves as well as in the squares.

227. BIOLOGY OF THE MEXICAN COTTON BOLL WEEVIL: III. THE MECHANISM OF GRUB FEEDING. By E. F. Grossman. (*Fla. Ent.*, **13**, 2, Gainesville, Fla., 1929. Abstr. from *Rev. App. Ent.*, vol. xvii., Ser. A, **11**, 1929, p. 617.) It is suggested that the larva of *Anthonomus grandis*, Boh., does not eat its way out of the cotton-boll, because it prefers the soft interior to the hard shell, and therefore mechanically avoids the numerous dangers to which it would be exposed on the exterior of the boll. In experiments with infested bolls in which the outer shells had been made as soft as the contents, or the latter dried as hard as the shells, the grubs in both cases began to bore through the walls.

228. THE BOLLWORM OR CORN-EAR WORM AS A COTTON PEST. By F. C. Bishopp. (*Fmrs.' Bull. U.S. Dpt. Agr.*, No. 1595, Washington, D.C., 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, **11**, 1929, p. 621.) Severe damage, estimated at £1,700,000 a year, is caused to cotton in the United States by *Heliothis obsoleta*, F. (cotton bollworm), which also attacks maize, tobacco, and other crops. The nature of the damage to the crop is described. One female may lay from 500 to 3,000 eggs. These are deposited on various parts of the plant, on weeds and upon the ground; on cotton only 20-40 per cent. are laid on the squares, blooms and tender growing tips. The larvæ mature in from twelve to seventy days, the bulk of the damage being caused during the last days of active feeding. Pupation takes place in the soil, the overwintering pupæ being found at depths of 4-6 inches, and those of the summer generations at depths of 1-4 inches. Under favourable conditions the life-cycle may be completed in thirty days, and there are four or even five generations a year.

Cotton is usually attacked by the larvæ of the third generation, and severe injury is caused in cloudy and rainy weather. The moistening of the soil apparently assists the moths to emerge more easily, and the stimulating effect of the moisture on the growth of stalks and leaves of cotton favours the development of the larvæ. Moreover, such weather conditions lessen the effectiveness of certain parasites of the bollworm. As the hard ripe bolls are less subject to injury by the larvæ, steps should be taken to make the plant mature before the bollworms begin to migrate from maize to cotton. It is also desirable to plant varieties of cotton that produce little foliage, since the moths hide in the leaves.

Among the methods of control suggested are: Deep autumn and winter ploughing; the early destruction of cotton stalks to prevent late bollworms from reaching maturity; a poison bait consisting of 50 lb. wheat bran, 1 lb. Paris green or white arsenic (or 2 lb. powdered calcium arsenate), 2 U.S. gals. low-grade molasses, and 3-4 U.S. gals. water, to be scattered over the fields at the rate of 10 lb. to the acre; dusting with calcium arsenate at the rate of 5 lb. to the acre. Calcium arsenate dust should be applied when the larvæ begin to hatch and are feeding on the surface of the plant.

229. CONFIRMATORY EVIDENCE OF THE VALIDITY OF THE SPECIES *Pectinophora scutigera*, HOLDAWAY (QUEENSLAND PINK BOLLWORM), FROM A STUDY OF THE GENITALIA. By F. G. Holdaway. (*Bull. Ent. Res.*, xx., **2**, 1929, p. 179.)

A study of the genitalia of both sexes of *Platyedra* (*Pectinophora*) *scutigera*, Holdaway (Queensland pink bollworm), originally named from the immature stages, has confirmed the validity of the species. Details of a comparative study of the genitalia of this species and of *Platyedra gossypiella*, Saund., are given and figured. The author considers that both species should be referred to the genus Pectinophora. (*Cf.* Abs. 77, vol. iv., p. 78.)

230. SOUTH AFRICA. *Cotton Pests*, 1928-29 *Season*. (*Farming in S. Afr.*, iv., **44**, 1929, p. 402.) *Sudan Bollworm* (*Diparopsis castanea*): Observations at Rustenburg showed a maximum pupal period of 690 days and a minimum of 20 days. Light traps were run in parallel series at Rustenburg and Sandfontein with a view to determining the practicability of this method as a control measure. 500 c.p. single-burner acetylene flares were tested. At Rustenburg 628 moths, of which 12 per cent. were females, were caught in 107 nights; at Sandfontein 478 moths, 5 per cent. of which were females, were caught in 79 days. In both cases the cost per moth irrespective of sex was 3d. per individual, which equals the price of 1 lb. of carbide. Comparative infestation counts at the end of the season on 90 plants in various parts of the plots around the lights, cleaned of Sudan bollworm infestation at the beginning of the test, showed 36 per cent. more clean bolls than on the same number of plants left as controls, which would seem to indicate that no decided advantage was gained through the traps.

An experiment conducted on the effect of variation of light intensity as represented by 70 against 280 candle-power acetylene flares showed, over a period of two months, 312 moths for the 280 candle-power—21 per cent. being females—and 190 for the 70 candle-power—25 per cent. being females. On a basis of cost per moth, however, the weaker light had the advantage of 1d. as against 2·7d. per individual. A very important feature noted was the consistently low number of females attracted to the light, and very few of these were gravid. Both these facts mitigate strongly against the practical use of the method.

American Bollworm (*Chloridea obsoleta*): This bollworm is parasitized by *Microbracon brevicornis*, which was found active at Barberton, and the rest of the season was devoted to a study of the parasite. The life-history in summer was found to be 1·7 days for the egg, 4·3 days for the larvæ, and 6·9 days for the pupal stage, the total averaging 12·9 days. The average longevity of the female was 25·1 days, the average number of eggs produced 200, and the maximum 678. The parasite permanently paralyzes the host larva by stinging, and may deposit a number of eggs on the same larva. Field parasitism of larvæ rose to 80 per cent. by the 16th October. Work is in progress with the object of experimental mass production of the parasite.

231. APHIDS. (*Agr. Leafl.* No. 14, Dept. of Agr. Iraq, 1927.) Gives instructions for spraying as a means of control, and an estimate of the cost in Iraq.

232. THE ROOT APHID (*Trifidaphis phaseoli*, Pass.) OF COTTON, POTATO, AND OTHER CULTIVATED CROPS. By A. K. Mordvilko. (In Russian.) (*Ann. Inst. Exptl. Agr.*, vii., **3-4**, Leningrad, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, **12**, 1929, p. 688.) The geographical distribution and economic importance of *Trifidaphis phaseoli*, Pass. (*perniciosa*, Nevskii), are discussed, and the literature recording its occurrence on various food-plants is reviewed. The character of the damage caused to cotton in Transcaucasia by infestation of the roots is pointed out.

For the control of the Aphid on cotton clean cultivation is recommended, and plantations should be established as far as possible from waste land. Measures that have been previously suggested are discussed, and include drainage of the fields to lower the level of the underground water, as excessive moisture favours

the development of the Aphids. After the usual irrigation of the fields before sowing, they should be ploughed to secure a more even distribution of the moisture in the soil; summer irrigation should be avoided.

3. La Avispa (*Scelio fuscipennis*, Ashm.) Como Parasito de Los Canutos de la Langosta en Mexico. (*S. fuscipennis*, a Parasite of the Egg-pods of Locusts in Mexico.) By A. Dampf. (*Bol. mens. Defensa agric. Sec. Agr. Fom. Mexico*, iii., **1-4**, p. 18, S. Jacinto, D.F., 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, **11**, 1929, p. 613.) *Scelio fuscipennis*, Ashm., was obtained in 1926 from the egg-pods of the migratory locust, *S. paranensis*, Burm., in Mexico, this being the first record of the occurrence in that country of this type of parasite.

234. Cotton Louse Control. By B. R. Coad *et al.* (*Leaf. U.S. Dpt. Agr.*, Washington, D.C., 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, **12**, 1929. p. 718.) A brief popular account is given of the method of controlling *Aphis gossypii*, Glov., on cotton by dusting with nicotine sulphate. A home-made ball mill for mixing the dust is described.

5. Cotton Stainers and Internal Boll Disease. By E. S. Moore and G. C. Ullyett. (*Farming in S. Afr.*, iv., **46**, 1930, p. 508.) A general account of the large red cotton stainer which is well known in the cotton-belt of the Union, and is the cause of internal boll disease.

The eggs of the stainer are deposited in batches containing approximately 150 eggs. These hatch in from six to twelve days, the newly-hatched nymphs remaining below the surface until the first moult, after which they come above ground. Four more nymphal stages are passed through before the adult stage is reached, and each of these is separated by a moult and is marked by an increase in size. The total period occupied by the five nymphal stages varies from twenty-nine days in summer to fifty-seven days in winter. The adults live from thirty-nine to eighty-six days, during which time a single female may deposit as many as twelve batches of eggs or a total of nearly 1,400 eggs. On an average about 80 per cent. of the eggs hatch.

At the moment there are no efficient methods of control for stainers in existence in the Union, and research is being devoted to the study of attractants, poisoned baits and contact insecticides.

236. The Cotton Cicada. By V. Yakhontov. (In Russian.) (*Khlop. Delo.*, viii., **7**, Moscow, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser A, **11**, 1929, p. 647.) An account of observations on *Cicadatra ochreata*, Mel., which has caused considerable damage to cotton in Bokhara during the last two or three years. The distribution of this Cicadid in the region is discussed, and all its stages are described. The only injury to cotton is caused by the oviposition punctures, since the larvæ and adults feed on other plants. Oviposition begins about a fortnight after the emergence of the adults. As many as 52 deep punctures sometimes occur on the stem of a cotton plant, probably made by several females; single individuals were observed making 11-14 punctures each at a time. The female lays 10-15 eggs in each of the egg chambers, which are very deep and extend as far as the centre of the stem or traverse it entirely, causing the plant to wither quickly. Even under very favourable conditions the cotton is usually so much weakened that it cannot produce a normal crop.

The adults of the Asilid, *Satanas gigas*, Ev., are predacious on those of *C. ochreata*, and an unidentified Chalcid was found feeding externally on the eggs, of which several were attacked by the same larva.

C. querula, Pall., has also been observed ovipositing in the stems of cotton in Bokhara, but it only occurs in comparatively small numbers.

237. The True Cricket: A Serious Cotton Pest in California. By E. A. Macgregor. (*Circ. U.S. Dpt. Agr.*, No. 75, Washington, D.C., 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, **12**, 1929, p. 712.) Serious losses are caused to cotton in California by the cricket *Gryllus assimilis*, F., which sometimes renders replanting of seedlings necessary. The crickets, which hibernate in all stages, are to be found in cotton-fields throughout the growing season. The broods are not very distinct, but apparently the spring generation from over-wintering eggs requires about eleven weeks for development, and the second about eight; there is only a partial third generation. Hibernating adults are merely quiescent and feed to a limited extent during the warmer intervals. Cotton is attacked on the stem and foliage. In very young plants, the stem is usually severed just above the ground; in plants from 3 to 8 inches high, the stems are gnawed irregularly, often on both sides, so that they easily break off; in taller plants the apical buds are frequently severed from the stem. The attack on cotton is most likely to occur in fields where cotton follows a winter crop of grain, especially barley, as the soil of barley-fields is covered with cracks and is not cultivated until the wintering crickets have emerged, and the cotton is planted late; probably more than one egg-mass is deposited, and under favourable conditions in the laboratory the average progeny from one egg-mass is about seventy-five. The method of oviposition is described. The incubation period in late August and early September is from eight to fourteen days. There are very few natural enemies, a large red mite of the genus *Euthrombidium* being probably the only important one; several birds feed on the crickets.

The planting of cotton after cereals should be avoided wherever possible. Frequent cultivation will eliminate crevices, etc., in which the crickets shelter in the daytime, and the borders of cotton-fields should be cleared of weeds. As crickets have been caught in numbers by ordinary lanterns placed over pans containing water and kerosene, it is suggested that light-traps placed about cotton-fields would destroy large numbers, and poisoned baits should also be very successful.

The Locust Invasion of Palestine During 1928. By G. E. Bodkin. (*Bull. Ent. Res.*, xx., **2**, 1929, pp. 123-39. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, **11**, 1929, p. 652.) The organization of the 1928 campaign against the pest is described, and special stress is laid on the necessity of predicting the outbreaks for the purpose of providing an ample supply of apparatus, baits, etc. Flame-throwers, which are described and figured, were used with great success in exterminating swarms prior to egg-laying. The cost of a charge, which can burn for ten minutes continuously, is 1s.; in practice, however, the flame is usually applied in short bursts. The method of destroying the hoppers by means of pits with barriers of zinc sheets, which was also employed in the campaign, is explained in detail.

9. A Contribution to the Study of the Desert Locust (*Schistocerca gregaria*, Forsk.). By F. S. Bodenheimer. (*Hadar*, ii., No. 7, Tel-Aviv, 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, 1929, p. 632.) Advantage was taken of the opportunities offered by the recent invasion of *Schistocerca gregaria*, Forsk., in Transjordania to endeavour to solve some of the outstanding problems in its biology, and this article is a preliminary summary of an extensive treatise that is to appear shortly.

The first problem discussed is the effect of temperature and humidity on the development of the eggs. Laboratory experiments indicate that the optimum conditions are 100 per cent. humidity and a temperature of 25·5-30° C. (78-86° F.). The permanent breeding-places of *S. gregaria* are situated in areas that border on deserts, but in which rainfall is still a climatic factor. If sufficient rain falls

during the oviposition season and the temperature of the soil averages about 30° C. at that period, as many as 80 per cent. of the eggs reach maturity. Two favourable years in succession are sufficient, therefore, to cause a serious outbreak.

The author further discusses the relation of the body temperature of the locust to the temperature of the atmosphere and of the soil, and submits tables showing its behaviour throughout the day and its reactions to different temperatures, as well as the temperatures preferred by the various stages.

240. THE DESERT LOCUST (*Schistocerca gregaria*, Forsk.). By B. P. Uvarov. (In Russian.) (Moscow, Chief Cotton Committee, U.S.S.R., 1929. Abstr. from *Rev. App. Ent.*, xvii., Ser. A, 11, 1929, p. 632.) A brief summary of data from the literature on the bionomics, distribution, parasites, and control of *S. gregaria*, Forsk., which invaded nearly the whole of Transcaspia and the south-western part of Turkestan in 1929. It is probable that northern Khorosan and southern Transcaspia are the permanent breeding-places of the solitary phase of this locust, for isolated individuals have been found there on several occasions. The periodic outbreaks of *S. gregaria* in general, and the invasions of 1915 and 1929 in particular, may be connected with the periodicity of the sun-spots; these have a direct influence upon the climate, which may be the governing factor in this problem.

241. A STUDY ON FLIES PARASITIZING THE ASIATIC LOCUST (*Locusta migratoria*, L.) AND THEIR SUPERPARASITES. PT. I., PARASITES OF THE LARVÆ AND FULL-GROWN INSECTS. By N. G. Oisoufiev. (In Russian.) (*Rpts. on App. Ent.*, iv., 1, Leningrad, 1929, p. 61.) From the summary, which is given in English, we learn that the following parasites of larvæ and full-grown locusts were studied: *Blæsoxipha lineata*, Fall., *B. filipjevi*, Rohd., *B. grylloctona*, Lw., *Acridomyia sacharovi*, Stack., and *Chalcis dalmani*, Thoms.

242. BORDEAUX MIXTURE. (*Queens. Agr. Jour.*, xxvii., 5, 1929, p. 487.) If Bordeaux mixture is to give satisfactory results in the control of fungus diseases, it is important not only that it should be properly prepared, but that the ingredients be pure.

Samples of bluestone sometimes come on to the market which contain a quantity of sulphate of iron, and it is as well that the grower should know the difference. Bluestone proper should be in the form of dark-blue crystals, while the adulterated mixture is a lighter blue; indeed, the characteristic colour of sulphate of iron is a light green. The bluestone may be tested by dissolving a few crystals in water and adding a little ammonia. A pale blue precipitate is formed which dissolves to an intense blue colour, and the solution remains perfectly clear and free from sediment if allowed to stand for a while. If a reddish sediment settles, it is due to the presence of iron.

It is important that the lime used should be freshly burnt. To test whether it is so, a few lumps should be placed in a heap and sprinkled with water, when it will gradually fall to pieces, becoming very hot in the process, giving off a quantity of steam, and crumbling to a fine, white powder. Some lime may not crumble readily with cold water, but may do so with hot water. If it does not get hot enough to give off steam even with hot water, then the lime is unsuitable.

243. DUSTING EXPERIMENTS IN FLORIDA. (*Ann. Rpt. Fla. Agr. Exp. Sta.*, 1928, recently received.) Experiments with various commercial dusts showed that none of the dusting treatments were of much use in controlling seedling diseases of cotton. The chief diseases attacking cotton were: Sore-shin, caused by several species of fungus parasites, particularly *Rhizoctonia solani*, Kühn; Angular leafspot, caused by a bacterium *Pseudomonas malvacearum*, E.F.S.;

and Cotton wilt, caused by *Fusarium vasinfectum*, Atk. It was found that the *Fusarium* causing boll rots also caused a serious damping-off of cotton seedlings.

244. SEED TREATMENT TEST. By W. R. Perkins and W. W. Welborne. (*Miss. Sta. Bull.*, **266**, 1928. Abstr. from *Exp. Sta. Rec.*, lxi., **5**, 1929, p. 446.) A report is given on experiments with nine different organic mercury compounds and two iodine mixtures for the control of damping-off and wilt of cotton. Due to a second planting no data were secured on the control of damping-off. None of the treatments reduced wilt infection to an important degree. All plats planted with treated seed yielded more seed cotton than those planted with untreated seed, the calculated increases being from 26 to 108 lb. of seed cotton per acre.

245. SEED TREATMENT FOR SEED-BORNE DISEASES OF COTTON. By H. F. Wallace. (*Miss. Sta. Bull.*, **262**, 1928. Abstr. from *Exp. Sta. Rec.*, lxi., **5**, 1929, p. 446.) Various fungicides were tried for the control of seed-borne diseases, and the best results were obtained with iodine preparations.

246. RAPPORT MYCOLOGIQUE SUR LA CAMPAGNE COTONNIÈRE DE 1927 AU MANIEMA ET AU KIVU. By P. Staner. (*Bull. Agr. Congo Belge*, xix., **4**, 1928. Abstr. *Rev. App. Mycol.*, ix., **1**, 1930, p. 32.) Notes on diseases of cotton observed during 1927 at Manyema and Kivu, Belgian Congo. Damping-off of young plants (*Rhizoctonia bataticola*) [*Macrophomina phaseoli*], reported at Sankuru in 1925, was present in two localities in Manyema. Mosaic-like patches on the leaves were produced by *Cercosporella gossypii*, *Bacterium malvacearum*, *Cercospora gossypina*, *Macrosporium nigricantium*, and *Helminthosporium gossypii*. Boll-rot and black-arm caused by *B. malvacearum* were prevalent and dangerous in the vicinity of Nyangme and south-east Manyema. Anthracnose due to *Colletotrichum gossypii* was also present, and the perithecia of the perfect stage of this fungus, *Glomerella gossypii*, were once observed on dead bolls.

247. DISEASES OF ECONOMIC PLANTS IN PERU. By E. V. Abbott. (*Phytopath.*, xix., **7**, 1929, p. 645. Abstr. from *Rev. App. Mycol.*, ix., **1**, 1930, p. 63.) Leaf, bract, and boll spot of cotton (*Helminthosporium gossypii*) is widely distributed but causes little injury. Mildew (*Ovulariopsis gossypii*) has also been observed. Cotton in moist soils may suffer severely from the attacks of this fungus, which causes leaf curl and premature defoliation.

248. SOUTH AFRICA. *Cotton Diseases*, 1928-29 *Season*. (*Farming in S. Afr.*, iv., **44**, 1929, p. 411.) During the season under review various damping-off and wilt diseases were sent in for examination and diagnosis. Fusarial wilt did not appear among them, but a *Rhizoctonia* was proved to destroy the plants, and a *Phoma*, sp., is under suspicion. Internal boll disease was present in the Low veld, and observations confirmed the findings of previous seasons—viz., that it is caused by *Nematospora* (mainly *N. gossypii*) introduced by the punctures of stainers.

249. THE MORPHOLOGY AND CYTOLOGY OF *Bacterium malvacearum*, E. F. S. By R. H. Stoughton, Rothamsted. (*Proc. Roy. Soc.*, B, **105**, 1929, p. 469.) During studies on the angular leaf-spot disease of cotton, based upon material supplied by Mr. Massey from the Sudan, the production of unusual forms was often observed. The following summary is given: *Bacterium malvacearum* has hitherto been described as possessing no internal structure or reproductive bodies, and as multiplying solely by transverse fission. A technique is described for staining without previous drying or fixing, and using this, several structures and a variety of different morphological forms have been observed. An internal central structure is described, which passes through a division cycle, which is

correlated with the division of the cell body, and is suggestive of nuclear division. Small granules with a strong affinity for basic dyes are described. These are formed in the wall of the cell and are liberated by simple extrusion, or grow out on a stalk from the end of which they are freed. These bodies resemble the "gonidia" of other writers. The occurrence and mode of formation of spherical coccus-like bodies in old cultures is described. "Giant-cells" and other atypical forms have been found to occur in old cultures.

250. COTTON ROOT ROT. (*Science*, lxxi., 1930, p. 128.) The third annual conference of workers with the *Phymatotrichum omnivorum* root rot was held on January 15 at Temple, Texas. Forty papers were presented, giving the results of work during the past year at the various State and Federal stations where the disease is under investigation. These papers will be summarized in a forthcoming report in *Phytopathology*.

251. FURTHER STUDIES OF COTTON ROOT ROT IN ARIZONA, WITH A DESCRIPTION OF A SCLEROTIUM STAGE OF THE FUNGUS. By C. J. King and H. F. Loomis. (*J. Agr. Res.*, 39, **9**, 1929, p. 641.) Pure cultures of the cotton root-rot fungus show that it is capable of living on dead tissues in the soil, and that it may survive on various roots that act as carriers. The sclerotia also seem capable of life for a considerable time, so that infected soils may easily spread the disease.

[*Cf.* Abstract **116**, p. 75.]

252. COTTON ROOT-ROT SCLEROTIA: OCCURRENCE. By D. C. Neal. (*Science*, 1929, **70**, 409-10. Abstr. from *Summ. of Curr. Lit.*, ix., **22**, 1929, E. 34.) Viable sclerotia of the cotton root-rot fungus (*Phymatotrichum omnivorum*) have been found under natural conditions in the soil of infested cotton-fields in Texas, showing that this fungus is a soil organism not restricted to living roots of susceptible host plants, but having an independent means of over-wintering and dissemination.

253. PLANTS SUSCEPTIBLE OR RESISTANT TO COTTON ROOT ROT, AND THEIR RELATION TO CONTROL. By J. J. Taubenhaus *et al.* (*Texas Sta. Bull.*, 393, 1929. Abstr. from *Exp. Sta. Rec.*, 61, **6**, 1929, p. 536.) A state-wide survey was made of cultivated and non-cultivated plants to determine their susceptibility or resistance to root rot caused by *Phymatotrichum omnivorum*. Of the cultivated plants tested, 274 were susceptible and 135 resistant, and of the non-cultivated plants, 244 susceptible and 66 resistant. Such weeds as the common tievine, soft ground-cherry, and several species of Solanum were found to be susceptible, and because of their perennial nature they serve as important carriers of root rot.

254. EFFECTS OF POTASH FERTILIZER ON COTTON WILT. By W. R. Perkins and W. W. Welborne. (*Miss. Sta. Bull.*, **266**, 1928. Abstr. from *Exp. Sta. Rec.*, 61, **5**, 1929, p. 446.) The results are given of a series of tests of potash derived from various sources on the reduction of cotton wilt. From an examination of 300 stalks of cotton from each plat an appreciable reduction of wilt was observed. The plats which received kainit, and some of the potassium chloride-treated ones, showed the greatest reduction in the percentage of wilt infection.

255. STUDIES IN THE GENUS FUSARIUM, VII. ON THE DIFFERENT DEGREES OF PARASITIC ACTIVITY SHOWN BY VARIOUS STRAINS OF *F. fructigenum*. By C. C. Harvey. (*Ann. Bot.*, xliii., 1929, p. 245.) At least four grades of parasitic vigour were shown correlated in a general way with morphological character, being greatest in the strain which shows the greatest tendency to the mycelial type of growth.

256. Tabulation of Alternaria and Macrosporium. By P. A. Young. (*Mycologia*, xxi., 3, 1929, p. 155. Abstr. from *Rev. App. Mycol.*, ix., 1, 1930, p. 1.) To assist in the classification of the species of *Alternaria* and *Macrosporium* used in his study of facultative parasitism, the author has prepared a table of all the described species in Saccardo's Sylloge, the first column of which contains the generic names of the hosts, the second the names of the host families, the third and fourth the length and breadth measurements of the spores in microns, while the fifth gives references to the description of the species in the Sylloge. A bibliography of thirty-four titles is appended.

257. Studies of *Sclerotium rolfsii*, with Special Reference to the Metabolic Interchange between Soil Inhabitants. By H. R. Rosen and L. Shaw. (*J. Agr. Res.*, xxxix., 1, 1929, p. 41. Abstr. from *Rev. App. Mycol.*, ix., 1, 1930, p. 49.) The purpose of the investigation reported in detail in this paper was to study the interaction of two soil-inhabiting fungi in limiting or favouring each other's growth. The organisms used to this end were *Sclerotium rolfsii* (a very severe outbreak of which occurred in 1928 on cantaloupe melons in Arkansas and Virginia), and the cotton-wilt fungus, *Fusarium vasinfectum*. Preliminary experiments showed that *S. rolfsii* is well able to utilize cellulose for its nutrition. On potato-dextrose agar at various H-ion concentrations it showed itself to be markedly tolerant of acid conditions, growing well at all pH values from 3 to 6·5. Beginning with pH 7, and extending into the alkaline range, there was a noticeable falling off in growth of mycelium, as well as in sclerotial development, and growth ceased altogether at pH 8. On the same medium *F. vasinfectum* grew well throughout the range of H-ion concentration tested—*i.e.*, from pH 3 to 9. When the two fungi were plated together on dehydrated potato dextrose agar, *S. rolfsii* rapidly outgrew *F. vasinfectum* at pH values below 6·9, and in time completely covered the latter, while the converse was the case around the neutral point and in the alkaline ranges. Alkaline media in which *F. vasinfectum* had grown for some days became sufficiently changed in reaction to permit rapid germination and growth of the sclerotia of *S. rolfsii*. When the latter was grown on media originally possessing acid reactions, and which had been used for growing *F. vasinfectum* prior to its introduction, it exhibited negative chemotropic responses by refusing to grow in the area immediately around the original colonies. In a final series of experiments it was found that the type and quantity of inoculum of *S. rolfsii* are very important factors in the capacity of the fungus to overcome reactions of the substratum that are unfavourable to the germination and growth of the sclerotia.

[*Cf.* Abstract **220**, above.]

GENERAL BOTANY, BREEDING, ETC.

258. Studies on the Transport of Nitrogenous Substances in the Cotton Plant. I. Preliminary Observations on the Downward Transport of Nitrogen in the Stem. By E. J. Maskell and T. G. Mason. (*Ann. Bot.*, xliii., 1929, p. 205.) The work was done upon the dried material obtained in the study of carbohydrate transmission [Abstract **342**, vol. v., p. 206, and **106**, vol. vi., p. 90], and the following abstract is given: The nitrogen content of the leaf increases by day and diminishes by night. That of the bark, just below the foliage region of boll-bearing plants, shows no appreciable variation, but in boll-less plants that of the bark behaves like that of the leaf. Removal of a ring of bark causes an accumulation of nitrogen in bark and wood above the ring, and a decrease below. It does not prevent movement of inorganic nitrogen into the leaf. Downward movement of nitrogen will take place through isolated flaps of bark. Isolation

of wood from bark prevents accumulation of nitrogen in the wood above a ring. Removal of varying fractions of the bark brings about a decrease in the total amount of nitrogen transported, but an increase in the rate of transport per unit cross-sectional area over the constricted region. The average weight of nitrogen compounds, expressed as asparagine, moving down the stem was 14·75 per cent. of the average weight of carbohydrate moving downwards. On the average, the absolute amount of nitrogen in the wood of the lower part of the stem is about equal to that in the bark, but the variation in the wood in response to variations in supply or demand is about twice that in the bark.

II. OBSERVATIONS ON CONCENTRATION GRADIENTS. (*Ann. Bot.*, xliii., 1929, p. 615.) The central problem is stated thus: Are variations in the rate and direction of longitudinal movement of organic nitrogen in the bark determined by longitudinal concentration gradients of the mobile form of nitrogen in the channels of transport, and, if so, is the acceleration in the rate of transport of the same order as that found for sugars? It was found (*cf.* Summary, p. 650) that the concentration gradients in the bark of total sugars and of organic crystalloid nitrogen were in opposite directions, the movement of nitrogen being against the gradient. The leaves and wood, however, show gradients in the direction of movement. If there is, therefore, a gradient basis for movement of nitrogen in the bark, it must be masked, either chemically (by negative gradients of immobile compounds) or regionally (by negative gradients of the mobile substances in the parts of the bark that do not serve for transport). Analysis showed definite negative gradients of asparagine and amino-acids in the bark as a whole, thus inferring (though it could not be proved) a small positive gradient in residual nitrogen. It was also against the idea of regional masking, and rather indicated that amino-acids or residual nitrogen may be concerned mainly with transport, while asparagine is concerned mainly with storage.

(These two papers and a third also dealing with the Transport of Nitrogenous Substances in the Cotton Plant have just been published as a separate memoir by the Corporation. Price 2s. 6d. post free.)

259. COTTON PLANT: GROWTH. By S. A. Kudrin. (*Chem. Abs.*, 1929, **23**, 4998 [from *Pflanzenernähr., Düngung u. Bodenk.*, 1929, **13***a*, 91-3]. Abstr. from *Summ. of Curr. Lit.*, ix., **23**, 1929, A. 18.) The cotton plant was studied as to the fresh weight of material produced, air-dried weight of material produced, absolutely dry weight of material produced, and chemical composition at five stages of growth: (1) with the formation of the third leaf; (2) bud formation; (3) bloom stages; (4) the beginning of ripening; (5) the first harvest. The chemical studies showed a decrease of the relative amounts of nitrogen and ash constituents with increasing age. The largest amounts of nitrogen and phosphorus were found in the blooms and seeds, while the largest amounts of calcium and magnesium were found in the leaves and stems. With increasing plant growth the nitrogen and ash constituents migrate from the vegetative to the generative organs. In the last stages of development investigated (the first harvest stage) two-thirds of the total nitrogen and phosphorus compounds of the cotton plant were in the generative organs, while the larger part of the calcium remained in the vegetative organs. The magnesium in this stage was more or less equally divided in both classes of organs. Between the bud formation and bloom formation stages, the cotton plant absorbed the largest amounts of nutrients from the soil. During this time an increased absorption of calcium and nitrogen compared with phosphorus and magnesium occurred. The cotton plant has a high requirement for nutrients, but it so happens that the large quantities of these nutrients are not removed with the harvest of the cotton, but are returned to the soil.

260. COTTON: NITROGEN CONTENT. By M. M. Tschilikin. (*Textilber*, 1929, **10**, 883-4. Abstr. from *Summ. of Curr. Lit.*, ix., **23**, 1929, B. 64.) An investigation

has been made of the effect of various mechanical and chemical treatments on the nitrogen content of cotton. Nitrogen determinations were made by the Kjeldahl method. A combed Egyptian cotton gave a nitrogen content of 0·27 per cent., a particularly dirty Turkestan cotton gave 0·5 per cent., a ripe cotton boll 0·79 per cent., and a dark-coloured seed coat 0·44 per cent. The dirtier the cotton, therefore, the higher is the percentage of material containing nitrogen.

261. A RAPID METHOD OF TESTING VIABILITY OF SEEDS. (*Science*, N.S., lxx., 1804. Abstr. from *Agr. J. India*, xxiv., **6**, 1929, p. 430.) Dead or alive? That is the question thousands of agricultural laboratories in all parts of the world have to answer when testing seeds and grains. If the seed is dead, it will not germinate when sown. A new test, devised by a Russian botanist, Dr. D. N. Nelubov, of Leningrad, will answer this important question in a few hours, instead of several days required by the ordinary methods. Aniline dyes are used by Dr. Nelubov to tell apart seeds that are dead and alive. The seeds are steeped in a weak dye solution for three to four hours. Those able to germinate are not affected at all by the treatment, while the "dead" ones give themselves away by getting deeply coloured. If seeds have hard husks they must be first broken, to enable the dye to penetrate to the embryo. Not all aniline dyes are suitable for this work. Dr. Nelubov finds that the best results are obtained with indigo-carmine. About one-fifth of an ounce of the dye is required per one gallon of water.

262. RECENT WORK ON THE GENETICS OF COTTON. By S. C. Harland. (*Trop. Agriculture*, vii., **1**, 1930, p. 16.) A careful discussion of the subject, with many details as to crosses that have been, and may be, effected. A paper that should be read by all students of the subject.

263. THE INHERITANCE OF CERTAIN SEED, LEAF, AND FLOWER CHARACTERS IN *Gossypium hirsutum* AND SOME OF THEIR GENETIC INTER-RELATIONS. By W. A. Carver. (*J. Amer. Soc. Agr.*, 21, **4**, 1929, pp. 467-480. Abstr. from *Exp. Sta. Rec.*, 61, **7**, 1929, p. 629.) Neither sterility, abnormal characters, nor non-Mendelian segregations were observed at the Florida Experiment Station in the F_1 and F_2 generations of crosses between standard and unimproved varieties of *G. hirsutum*. This is in contrast to the findings of several workers who made studies of the inheritance in crosses between *G. hirsutum* and *G. barbadense*. The naked seed and fuzzy tip seed characters proved to be simple Mendelian dominants to entire fuzzy seed. Five naked seed characters with lint percentages ranging from about 30 to practically no lint were found to be genetically identical with regard to the absence of seed fuzz. In F_1 naked seed was dominant to fuzzy tip seed, and segregated in F_2 in the ratio of 12 naked : 3 fuzzy tip : 1 fuzzy. Both green seed fuzz and brown seed fuzz were dominant to white seed fuzz, each cross giving a simple monohybrid segregation in F_2. Green seed proved dominant to brown. When all the possible crosses were made, using the characters red leaf, petal spot, naked seed, buff anthers, and okra leaf, no indication of linkage was evident between any of the characters in the F_2 generations.

264. LINKAGE VALUES: CALCULATION. By M. Alam. (*Mem. Dpt. Agr. India*. 1929, **18**. Abstr. from *Summ. of Curr. Lit.*, ix., **23**, 1929, A. 18.) A number of methods for calculating linkage-values from an F_2 population are compared. The comparison is based on tables similar to those suggested by Collins. Several examples from certain well-known data of linkage relationships are taken, and the linkage intensities calculated by all the typical methods. The solutions obtained are tested by the measure of discrepancy χ^2. The comparisons show the superiority of the product ratio method. The author suggests several simple formulæ for calculating linkage-values directly from the product ratio. The coefficient of correlation p should be used only when the phenotypic ratios are

very complicated, and when there is no evidence of any differential viability of the zygotic classes. A few graphs are given to illustrate the relationship of the cross-over percentage with the zygotic classes and also with the constants p and k. These graphs show why in close repulsion it is difficult to arrive at an accurate recombination value. A general method by which the value of p^2 can be found out from any constant expressed in terms of the zygotic classes a, b, c and d, and for any zygotic distribution, is suggested.

265. Cotton Notes. By S. C. Harland. (*Trop. Agriculture*, vi., **12**, 1929, p 351.) *The Causes of Fluctuation in Ginning Percentage :* Dr. Harland discusses the work of Balls, Barritt, and Turner on ginning percentage, etc., and from the standpoint of genetics summarizes the position as follows: (1) Mean weight of seed and mean weight of lint per seed are constant for a given pure line under optimum environmental conditions. (2) Since weight of lint per seed is determined by two factors—(*a*) number of hairs per seed and (*b*) mean hair weight—it follows that these also must be determined by hereditary factors. (3) Variations in ginning percentage may be due to hereditary or environmental factors acting on either seed weight, number of hairs per seed, or hair weight. Some intercorrelation no doubt exists in all these three factors, and the best way of studying such intercorrelation would be based on a study of a large number of pure lines.

The Structure of the Seed Coat of Cotton : Deals with the work of Barritt on this subject (*cf.* Abstract **638**, vol. vi., p. 375). Dr. Harland concludes with the following paragraph: "The author expresses surprise that in Egypt a correlation is supposed to exist between the presence of fuzz and good quality cotton, and even forms the basis for selection among persons of technical training. Ideas of this kind, however, should not be lightly dismissed. At this laboratory we have found that in certain crosses a strong positive correlation may exist between the amount of fuzz on the seed and the amount of lint, and it is conceivable that the opinion on the desirability of much fuzz on the seed may be based on its association with the abundance of lint rather than with its quality."

FIBRE, YARN, SPINNING, WEAVING, ETC.

266. Cotton Opening Machines. By K. Quaas. (*Leipziger Monats. Text. Ind.*, 1929, Sonderheft 3, 119-21. Abstr. from *Summ. of Curr. Lit.*, ix., **23**, 1929, F. 19.) In a discussion of modern cleaning machines for cotton, a combined bale breaker and hopper bale opener for highly compressed cotton is shown, and a layout, comprising a hopper feeder, preliminary opener, dust boxes, exhaust dust cage, Crighton opener (contrary to its usual position before the dust box), hopper feeder, and single scutcher. This combination is particularly valuable for low-grade, dirty cotton; for ordinary American cotton the Crighton opener can be cut out.

267. Baled American Cotton: Moisture Content. (*Text. World.*, U.S., **76**, 1929, 2923. Abstr. from *Summ. of Curr. Lit.*, x., **1**, 1930, p. 12.) Samples of cotton from the warehouses of the North Carolina Cotton Growers' Co-operative Association were weighed, dried in an oven at 200° to 240° F. for three hours, after which period weighings were taken each half-hour until three weighings agreed. The total average per cent. regain was found to be 8·25 (gin cut and mixed staple not considered). The 1¼-inch staple samples contained the highest average moisture content, and the 1-inch staple samples the lowest amount.

268. Mildew in Cotton Goods: Prevention. By G. Smith. (*Text. Wkly.*, 1929, **4**, 301. Abstr. from *Summ. of Curr. Lit.*, ix., **23**, 1929, H. 13.) The nature of mildew and the development of mould are outlined. The following main points must be taken into consideration in attempting to prevent mildew in cotton

goods: (1) Both cotton itself and various sizing and finishing materials are excellent foods for various mould species. (2) Mildew cannot develop except in presence of moisture, but the amount of water required by many common species is extraordinarily small, provided other conditions are favourable. (3) Mould spores occur everywhere, are long-lived, and difficult to destroy, and are ready to germinate as soon as they reach a suitable environment. (4) Methods of packing used for the export trade ensure that the cotton shall be isolated from outside moisture, but they also ensure that any moisture originally present will be retained. (5) There is not one "mildew" but a diversified army, of which one or another unit can take advantage of almost any condition to which cotton is usually exposed. It has come to be generally accepted that, in medium and heavy sizing, 8 to 10 per cent. of zinc chloride, calculated on the weight of starchy materials, and about ½ per cent. of salicylic acid in light sizing, provide adequate protection against mildew. Mildew has, however, been observed on cloths containing much greater amounts of these antiseptics, and the author's opinion is that the mildew problem will never be completely solved by the use of antiseptics, however efficient.

9. THE RELATIONSHIP OF LINTERS TO THE CHEMICAL INDUSTRIES. By S. E. Seaman. (*Int. Cot. Bull.*, viii., **30**, 1930, p. 389.) Stresses the importance of the freedom of linters from foreign matter.

270. WORLD COTTON-SPINNING CAPACITY. SPINDLES FOR 1913 AND 1929 ANALYZED AND COMPETITIVE POSITION OF EACH COUNTRY. By W. H. Slater. (*Text. Rec.*, xlvii., **562**, 1930, p. 26.) A statistical analysis of the position in 1913 and 1929. Great Britain's spindles, though showing an actual increase, have fallen from 38·81 to 34·05 per cent. of the total. France and Belgium have very slightly increased their proportion, but the chief increase is in Asia, with a slighter one in America.

271. COTTON: SPINNING QUALITY. (*Text. Weekly*, 1929, **4**, 281. Abstr. from *Summ. of Curr. Lit.*, ix., **22**, 1929, G. 46.) The recognized limits of counts for various grades of cotton are shown in tables in which counts, staple length, twist constant, and lea strength are given.

272. FACTS AND FIGURES FAVOUR AUTOMATIC LOOMS. By M. Proctor Gregg. (*Int. Cot. Bull.*, viii., **30**, 1930, p. 355.) Deals with the subject under the following main heads: Warp and weft breakages; Repairing breakages; Analyzing stoppages; Battery filling; Loom drive; Cost.

273. AUTOMATIC LOOMS: NUMBER PER WEAVER. (*M/c. Guard. Comm.*, **1929**, **19**, 589. Abstr. from *Summ. of Curr. Lit.*, ix., **22**, 1929, I., 59.) Figures are given showing the number of looms formerly supervised by a weaver, together with the number of automatic looms allotted to him in American mills, where automatic looms have replaced non-automatic looms. The number of non-automatic looms per operative varies from 3 to 8, and the number of automatic looms from 8 to 32, according to the type of cloth woven. A more detailed comparison is given of automatic and non-automatic looms working on a 5·35 yards per pound print cloth 24×60, and the saving produced by the use of automatic looms is determined.

274. "PLATT-TOYODA" HIGH-SPEED AUTOMATIC LOOM. By Platt Bros. and Co., Ltd., Oldham. (*Text. Rec.*, xlvii., **562**, 1930, p. 38.) A patent automatic shuttle-changing loom which can be run under ordinary factory conditions at speeds over 200 picks per minute. The loom is fitted with patented mechanisms, including warp stop-motion, positive let-off motion, warp tension-evener device, and check straps.

275. TEXTILE COSTS. By J. Ryan. (*Text. Rec.*, xlvii., **562**, 1930, p. 31.) A useful account of the statistics of costs in the textile industry given under the following heads: Standard Cloths; Spinning Costs; Moisture Content; Double-shift Working; Wage Lists.

276. THE GERMAN TEXTILE INDUSTRY IN 1929. By Dr. A. Niemeyer. (*Text. Rec.*, xlvii., **562**, 1930, p. 24.) A general survey of the year 1929 leads to the conclusion that in all branches of the German textile trade it has been one of the worst business years known since the inflation period, and, apart from the crisis of 1926, it is probably the worst year that the German textile industry has ever experienced.

TRADE, CO-OPERATION.

277. COTTON TRADE STATISTICS. (*Text. Rec.*, xlvii., **560**, 1929, p. 25.) The second annual report of the Cotton Trade Statistical Bureau states that the trade records of the Bureau have been considerably extended, and the sources of information made more complete. The trade returns of six countries, including every market of importance to the Lancashire cotton trade, have been received monthly or quarterly as they appeared. Details of the cotton yarn and piece-goods exports of the chief producing countries, and of imports into all markets, are extracted regularly and recorded in a separate index, which is now the most comprehensive guide to international trade in cotton goods that can be compiled from the material at present available. It is intended gradually to enlarge this system so as to cover international trade in other textiles, especially those generally regarded as competing with cotton goods, such as rayon mixtures, and cotton and woollen mixtures. Various other matters regarding trade movements are described in the report.

278. THE COTTON INDUSTRY. By J. Morris. (*Text. Rec.*, xlvii., **562**, 1930, p. 35.) An interesting general account showing the merits of cotton for clothing and other purposes, and including statistics of production of cotton and other textile raw materials.

279. LINEN VERSUS COTTON. (*J. of Text. Inst.*, xx., **12**, 1929, p. 187.) An interesting statement of their rival claims.

280. COTTON BAGS FOR POTATOES. (*Int. Cot. Bull.*, viii., **30**, 1930, p. 392.) The Cotton Textile Institute in New York reports a steady increase in the use of cotton bags for packing potatoes in convenient quantities for retail distribution. Housewives are buying more of their supplies in these bags, and potato shippers are in favour of their use.

281. THE PROBLEMS OF THE COTTON INDUSTRY. By J. Ryan. (*J. of Text. Inst.*, xx., **12**, 1929, P. 188.) A general analysis of the situation, leading to the conclusion that regeneration must come in the direction of greater co-operation, (as organized, for example, by the Lancashire Cotton Corporation).

MISCELLANEOUS.

BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION. (*Rpt. of Dpt. of Sci. and Indus. Res.*, 1928-29, p. 123.) A considerable extension of the Shirley Institute has been opened during the year for researches into the application of rayon in conjunction with cotton. Sanction has also been given for a further extension of the Institute, providing over 12,000 feet floor space and designed like a small mill to accommodate machinery for spinning and

weaving. New machines, designed by the Association jointly with one of its members, have been patented to deal with the question of dust arising during carding operations, and it is believed that this drawback can now be avoided. An investigation is being carried out on the possibility of reducing shrinkage of cloth after washing, and steady progress has been made with the development of tests for the control of yarn and cloth-finishing processes.

283. THE LIVERPOOL COTTON ASSOCIATION: A BROADER MARKET. By A. C. Nickson. (*The Coml. Ann. Rev.*, January 30, 1930.) In this account of the year's operations, the author states that the Liverpool Cotton Association has broadened its articles to admit limited companies who are spinners of raw cotton, and also members of the New York and New Orleans Exchanges. Full agreement has been reached regarding the American standards.

284. IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD. From the Principal's Report for 1928-29 we learn that the new Chemistry Block has been completed during the year, and a wing added to the Sugar Factory. In addition, an Agricultural Field Office has been erected, and a further 18 acres of land acquired to meet the need for more land for agricultural purposes.

The Report outlines briefly the main lines of research that are being carried out, and states that satisfactory progress has been made. As in previous reports, a list is given of the papers published during the year, and the journals in which they have appeared.

285. COTTON: PARTIAL LIST OF PUBLICATIONS IN ENGLISH. Compiled by M. F. Warner. (*U.S. Dpt. Agr. Libr. Notes*, **4** (1929), Nos. 1-2. Abstr. from *Exp. Sta. Rec.*, lxi., **6**, 1929, p. 520.) This list, a continuation of the list by Hawks, embraces about ninety titles.

286. COTTON FACTS: EDITION OF 1929. This is a little book of great value, containing statistics of every kind, many of them very troublesome to come at under the usual circumstances. For example, one finds full tables of rainfall and temperature in all the cotton states, dates of killing frosts, figures relating to use of fertilizers, ginneries, crop movements, stocks, daily prices, futures, etc. The book is indispensable to all who are interested in the growing and marketing of cotton.

287. FROM COTTON FIELDS TO FINISHED PRODUCT. (*Text. Merc.*, February 7, 14, 1930.) These articles continue the series mentioned in Abstracts **657**, vol. vi., and **153**, vol. vii. The first deals with the raw material, its properties, and marketing methods; the second with the terms and conditions of the sale of yarn; conditioning and testing of yarn; defects in yarn, and their remedies.

PERSONAL NOTES

We offer our congratulations to Sir Cecil Bottomley on the conferment on him of the honour of K.C.M.G. Sir Cecil Bottomley represents the Colonial Office on the Council and Executive Committee of the Corporation, in which capacities he has rendered most valuable services.

We also offer our congratulations to Mr. F. L. Engledow on his election to the Drapers' Professorship of Agriculture at Cambridge, in succession to the late Professor T. B. Wood. The Corporation cannot but regret that Professor Engledow's new duties will prevent him giving the same close personal attention to the work of their students at Cambridge as he has done in the past, but it is gratifying to know that his advice and assistance will still be available on the Research Station and Studentship Selection Committees.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Ceylon	Dr. J. C. Hutson.
,,	Mr. L. Lord.
,,	Mr. C. D. V. Georgi.
Fiji	Mr. J. G. C. Campbell.
Gold Coast	Mr. W. C. Fishlock.
India (Central Provinces)	Mr. F. Plymen.
Kenya Colony	Mr. A. G. Bailey.
Nigeria	Mr. G. W. G. Briggs.
,,	Mr. J. O. Hewitt.
Nyasaland	Mr. F. Barker.
Sierra Leone	Mr. H. O. Luxford.
,, ,,	Mr. E. I. Nisbett.
Tanganyika	Mr. J. F. C. O'Brien.
,,	Mr. A. J. Wakefield.
Uganda	Mr. G. F. Clay.
,,	Mr. E. A. Ruck.

The following officers of the Corporation's staff abroad will shortly be arriving in this country on leave:

Nigeria	Mr. H. Hutchinson.
South Africa	Mr. P. A. Bowmaker.
Trinidad	Mr. J. B. Hutchinson.

Printed in Great Britain by Billing and Sons Ltd., Guildford and Esher

THE EMPIRE COTTON GROWING REVIEW

VOL. VII. JULY, 1930. NO. 3

THE PROGRESS OF COTTON GROWING IN THE TANGANYIKA TERRITORY

BY

A. J. KIRBY,

Late Director of Agriculture, Tanganyika Territory.

IN a journal like this REVIEW it would be inappropriate to present a mere statistical account of the progress of cotton-growing in the Tanganyika Territory; there are official publications which give this information, and contain references to others that may be usefully consulted.[1 2 3] The purpose of this article is to examine the influences, with their effects and reactions in relation to its progress, of the circumstances that surround or are made to surround a cotton industry that has been fostered by the efforts of two Administrations differing in the methods employed.

PROGRESS BEFORE 1914.

In the beginning, under German rule, the method of introduction of cotton-growing among the natives of the country was through official influence on behalf of the Colonial Economic Committee, whereby each hut owner in the coastal districts was to plant a half-hectare of cotton; but after the general rebellion of 1905-6 it was necessary to begin the work all over again.[4] Methods of encouragement then consisted in permitting the cotton to be grown among maize[4], the giving of bonuses by the Committee for good cultivation and sorting[5], and prizes to Akidas (official chiefs) for " encouraging " cotton-growing—a method that was followed by a lack of success which caused it to be abandoned before long; and, lastly, the declaration of a guaranteed price equivalent to 17 to 21 cents of a shilling a pound[6]—a plan that failed to increase confidence except in one

area, Mwanza,[7] because on the one hand private buyers overbid in competition for the cotton, and on the other there were firms that were able to lower the prices because they were allowed to distribute free seed to natives on condition that the cotton grown from it was sold to them and no other.[6]

By the use of these means, or often in spite of them, there was a quick recovery after the rebellion to the production by natives in 1908[6] of an amount of lint equivalent to 1,486 standard bales of 400 lb. (taken as the unit throughout this article), the best results being obtained in N. Tabora, Bagamoyo, Rufiji, and Kilwa, whilst irregularity of season is given as a cause of setback in Mwanza and Tanga.[4] In succeeding years, as at present, the differing seasonal conditions caused important variation of output as between districts[5 6]; but at that stage the differences both in time and of place appear to have been much greater, probably because the attempt was made to grow Egyptian kinds as well as Upland (from seed from Uganda and Nyasaland), although the experience of several seasons led eventually to a recognition of the superiority of the latter as the cotton of the country. The best indications of the extension of the industry among natives at this period are the increase of the amount of seed distributed for planting, from 177 tons in 1910 to 406 and 542 in 1912 and 1913, and of the output of lint from all sources to 10,349 bales worth £105,512 in the last-mentioned year, cotton thus obtaining a place by value immediately after the three chief exports (rubber, sisal, and hides and skins in order). The most effective influence in encouraging the extension of native cotton-growing appears to have been surveillance by the Administration to ensure payment of fair prices, rather than insistence on payment of minimum prices.[7]

Before the European war, production of cotton other than native was wrongly considered to be more hopeful of extension with the aid of steam ploughs and manures (actually employed) and of irrigation; and the records show[8] that in the period 1905-8, mostly in 1907-8, twelve companies, mainly or largely interested in cotton production by plantation labour, were registered with a total capital of £297,150, besides five other companies described as private. In spite of this, two-thirds of the whole production was usually native. In 1909 European plantings were 11,000 acres,[9] which in 1910 became 21,795 acres in pure planting on 165 plantations, and 13,306 acres with cotton between rubber or sisal—a total of 35,101 acres, which increased only to 35,770 in 1911.[10] A stern lesson was learned as to the necessity for growing the right kind of

cotton, for Egyptian, which was the kind mostly sown, chiefly because of its higher price, suffered much loss from pests and diseases through trying to grow it as a rain crop, and Caravonica, while failing generally, developed a pest new to cotton.[10] This, and the general experience with cotton as a crop for Europeans, chastened the earlier grandiose ideas of cotton as a plantation crop extending (through irrigation and railways) over vast areas in and near the Kilombero Plain, the Rift Valley, and the riftlands of Usangu and Rukwa.[9]

The final position can be indicated shortly by quoting a summary[10] of the reports made at the time, as follows: "The cultivation by Europeans existed at this time (1913) to a noteworthy extent, only in Mohoro, Kilwa, Lindi, Morogoro, and Mwanza. Experience was leading to the conclusion that cotton cultivation was not suited to some of the northern districts, chiefly owing to climatic conditions. Where these conditions are not unfavourable, the chief matter is to choose suitable soils, and in this connection it is not to be gainsaid that the desire to reduce the cost of cultivation, through the trust placed in modern farming implements, has led the planters to take up for cotton cultivation many soils unfitted for it, among such being the heavy soils of the high grasslands and savannahs, where the freedom from trees or the small stands of plants like acacia tempt exploitation. On such lands the poor state of the cotton is in striking contrast to the condition of this crop on the neighbouring native lands with lighter soils and cultivated with the hoe; although the natives themselves by no means choose always the best lands. Another cause of poor yields is the general want of a proper rotation of crops. What are greatly wanted are pest and disease resisting kinds with a short vegetative period."

Progress since 1914.

Unlike any other country of important size, the Tanganyika Territory (or German East Africa, as it was then) suffered a complete stoppage of all production for export until the Armistice, which put an end to the fighting among three armies which had had to live as far as possible on the country. With the reintroduction of a civil administration it became possible once more to give attention to the development of the country; cotton was then one of the first crops to receive care from the Department of Agriculture, newly formed in 1921; and, to put it shortly, progress was entered upon, the extent and fluctuations of which are best indicated by giving the table on p. 172 presenting the output of lint in bales of 400 lb. in the cotton-growing provinces in the years shown.

Since 1922, when it was 48 per cent., the native production of cotton has varied from 63 to 74 per cent. of the whole, the latter being the proportion in three years out of the seven. (The actual proportion is somewhat higher, as European planters sometimes illegally buy native cotton for helping to meet commitments on their own crop.) The great reduction of output in 1927 was caused by the fall in prices of the preceding year; but notwithstanding this setback the "record" output of 1928, amounting to nearly 33,000 bales, more than maintained the average progress attained in the four years after 1922, namely, 4,275 bales a year.[11] A cautious estimate based on an average price of 15 cents a pound for seed-cotton and a proportion of 70 per cent. of the whole for native production, shows that the cotton-growing native of the country has in the past nine years been enriched in cash by a sum of well over one million sterling.

Province.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.
Eastern (1)	4,295	3,330	5,401	9,690	7,635	13,606	7,099	18,767
Tabora (2)	—	—*	—*	440	913	1,538	1,027	1,197
Mwanza	805	2,902*	4,601*	5,327	8,777	6,719	6,622	11,056
Lindi (3)	2,227	645	966	1,383	2,138	1,399	852	1,314
Tanga (4)	—	260†	390	816	1,508	350	131	267
Northern (5) ..	—	—†	116	1,019	670	662	235	263
Mahenge	—	38	43	16	27	—	—	—
Bukoba	—	—	—	101	21	7	—	90
Iringa (6)	—	—	—	1	35	—	—	—
Totals	7,327	7,175	11,517	18,793	21,724	24,281	15,966	32,954

(1) Comprising Morogoro, Kilosa, Rufiji, Dar es Salaam and Bagamoyo Districts. (2) Comprising Shinyanga, Nzega, and Kahama Districts. (3) Comprising the hinterlands of Lindi and Kilwa. (4) Comprising Tanga, Pangani, and Usambara Districts. (5) Comprising Moshi and Arusha Districts. (6) Lowlands of Rungwe, north of L. Nyasa.

* Tabora included under Mwanza.

† Northern Province included under Tanga.

The plan followed in the Territory for encouraging the African to grow cotton has been to provide means for ready and fair marketing for cash; to remind him *appropriately early* in each season of the advantages of the industry to him and of the necessity for sowing, cultivation, and harvesting, and for the destruction of old plants; and to make seed from the best and earliest cotton easily available to him. A lesson in the prime importance of the first of these was obtained at the very beginning of the revived industry, when delay in providing facilities for sale of the seed-cotton in 1921 brought

down the production in the old Lindi District from the valuable level of 1,996 bales, produced under the encouragement of the Administration alone, to 545 in the next year—a setback from which cotton-growing in the area has never fully recovered. As regards encouragement through the distribution of seed, this was done somewhat lavishly in the early years, to stimulate the native farmer to take up the industry in the same manner, so that the total distribution to him quickly increased from 120 tons in 1921 to 1,368 in 1926. After this year, however, from motives of economy and because the seed became of export value to the ginner, the conditions under which the distribution was made were closely controlled and the quantity consequently reduced.

The broad policy has been to try to make cotton take its place among the ordinary crops of the native farmer as a product receiving attention in the same natural and customary way as he gives it to the others. For all this work we must not forget the necessary help of the ginner, who from a beginning which quickly grew to nineteen licensed ginneries in 1923, had eventually erected or restored forty public ginneries, of which thirty-five were licensed in 1928.[12] It is owing largely to the co-operation and fair dealing of the sound, non-speculative ginner that cotton has quickly reached the second place by value among the principal exports of the Territory, holding it until 1926, when it was transposed to the third place (which it still retains) only by the great growth of the coffee industry, in which the natives also take the preponderating share.

Influence or Effect of Various Conditions on Cotton Production.

This matter is of lively interest to all who are concerned with efforts for successful cotton production, and we can now follow up the purpose of this article by making a closer review of these influences, taking them one by one as briefly as possible, but at the same time remembering that production may be affected by two or more circumstances at once.

Effect of Production by Plantation Labour.—We may add some details to what has been said about this already, before proceeding to the similar consideration of the more usual kind of cotton-growing—that by small-holders. From beginnings about 1907 in Sadani, Rufiji, Kilwa, Lindi, Morogoro, and Kilosa,[13] cotton-raising by paid labour quickly came to be abandoned, for the greater part, and is now confined to Kilosa and Morogoro, with small sporadic and usually unsuccessful attention in Rufiji and Kilwa, and it gives about one-

quarter of the total production (8,542 bales[14] in the best year, 1928). By 1908 Sadani had seen about 112,000 acres laid out for plantation cotton, of which 1,000 were steam-ploughed, the production in the three previous years having been valued at £197, £1,458, and £2,920, in succession. The rate of yield in the last year was so small (through drought, it is stated, but doubtless largely through planting Egyptian cotton instead of Upland) that it was decided to try to irrigate the whole area from the River Wami, a scheme of which, however, only pathetic traces of beginnings remain, probably because the Wami follows the custom of the greater number of African rivers of withdrawing to its upper reaches at the time when its waters are most wanted. At about the same time, in Rufiji, "a whole succession" of publicly and privately owned cotton plantations was laid out under the auspices of the Colonial Economic Committee (with a cotton school at Mpanganya, where now is one of the Agricultural Department's Stations), the chief of which, for example, belonging respectively to the German East African Plantations Company and to H. Schubert, had areas of 52,000 and 25,000 acres; steam-ploughs were used and two ginneries (at Mohoro and Mpanganya) were erected; and the resulting small quantity of cotton that was left from destruction by pests was reported to be of good quality.

There is little use in continuing the dismal story, other equally tragic chapters of which are concerned with Lindi and Kilwa (where Mitafifi and Caravonica cotton were favoured as being thought drought-resistant), relieved by better success in Morogoro and Kilosa, in the latter chiefly through the Otto Company of Stuttgart, who erected a ginnery, introduced steam-ploughs and Wanyamwezi labourers, and laid out a great irrigation scheme. The most appropriate comments on all this work will be brought forth by a realization that by 1912 the total production of cotton in the country, European and native, was a poor ten thousand bales. It is of interest that the supremacy of the Morogoro-Kilosa area for plantation cotton-growing still remains, the greatest output being 7,893 bales in 1928 in a total non-native production of 8,542;[11] a production that equals at least the best from plantations before 1914, in spite of the great capital outlay and the large-scale work (with the wrong cotton) of that period. It is impossible to say, however, how far this is usually profitable, for it is a speculative industry. Its Greek owners do not distinguish between the results from the gaming-table and those from the hoe, and after a bad year take measures to assist themselves once more to speculate with the soil by leaving cotton temporarily for contracting for buildings and railways. Tanganyika

helps to point the general lesson of the cotton-growing world that, except when and where the highest-priced cottons can pay for capital outlay and their necessary meticulous care, or where the lower-priced are subsidized, it is only the small-holder (controlled or not) who can produce cotton successfully.

Influence of a Good Native Population.—A tribe or collection of tribes that is described as "good" may be so called because it is comparatively hard-working or because it is enterprising (in the best sense). It is the influence of the former quality, and of both qualities together, that has led to the preponderating success with cotton in Mwanza and Morogoro-Kilosa respectively. The Wanyamwezi and Wasukuma of Mwanza are comparatively energetic tribes capable of sustained action and willing to avail themselves of the benefits of what is brought to them, once they realize its advantages; whilst the influence of both these tribes, brought to Morogoro-Kilosa by the Germans (and again since 1919), together with that of the more enterprising Swahili from the coast, has produced in that area a population that grows cotton keenly and comparatively well, and is creating to an increasing extent native capitalists who farm on a small plantation scale, raising cotton with paid labour that they recruit from their own kind. The results of these favourable conditions were that, in the year of greatest production, 1928, the natives of Mwanza and Morogoro-Kilosa were credited in the returns of buying at markets and ginneries[14] with seed-cotton equivalent to 9,378 and 8,767 bales respectively, making together 18,145 bales in a total native production of 24,412 bales in the whole Territory.

Influence of Other Industries Requiring Paid Labour.—A policy is followed whereby the native is left free to choose what he will do for a living. As a result we find only a small, stationary cotton industry in such areas as Pangani (credited, before its administrative separation, with cotton from Handeni, where it is proving a useful resource of the native farmer), and Arusha-Moshi, where a man can get good wages for his labour on sisal and on coffee plantations respectively. This condition operates also to a small extent in the same way in Tanga and Usambara, but most of the inhabitants of these areas do not favour working on plantations, and, as will be seen, there are other reasons for the small and precarious production of cotton by them. In more than one area of the Territory, estate owners have shown fear lest the assistance given to enable food and export crops such as cotton or coffee to be grown properly by natives should diminish their labour supply; the prepotent factor has, however, remained—the natural attitude to work for wages of the tribes

concerned. For the future, in proportion as the estate planter of crops grown in the extensive way releases himself from the thraldom of the hoe by means of modern implements, so will his cares in regard to labour be largely decreased. And further, the fact that tribes have protected themselves from easy recruitment as labourers will have prevented the country from being faced with the difficulty of the reabsorption into the farming classes of a large number of its inhabitants who would have become helpless wage-earners.

Effect of a Demand for Food-crops or other Valuable Farm Products.—Dar es Salaam District, in the Eastern Province, may be taken as an example of an area where cotton production has made little progress, partly because the natives on suitable land have become accustomed to grow food-crops near a port and railway, where there is a demand for the results of their labour that makes the value of these little different from that of cotton. There is the case also of the Usambara-Tanga area, now producing much of the maize that the sisal plantations formerly obtained from Kenya. The demand by buyers for groundnuts (the product sixth in importance in the Territory), existing before cotton-growing became important, has probably the same effect to some extent in parts of Mwanza and in Northern Tabora; whereas if natives will adopt a balanced agriculture there is the possibility of mutual support for their food crops and the two cash crops as well. On the other hand, it is not the case that cotton-growing affects the production of such crops as coffee and rice (respectively second and seventh by export value in the Territory), because of the very different conditions that are suitable for their growth; rice-growing, indeed, ought to increase cotton-growing, since it is often harvested early enough for cotton to be raised in the drying lands in which it has grown. In a general way, as natives are taught, cotton assists in the production of food and other crops because (like sugar-beet in England) the comparatively high value of its product permits it to be given additional cultivation that increases the yield of crops following it, and because its long season on the land keeps this clean to a useful extent for the planting of short-rains crops.

Influence of Lack of Internal Transport.—This has caused the production of cotton to remain stationary or to make only slow progress in some areas, such, for example, as Kilwa, Lindi (in early years), Rufiji, Bagamoyo, and Handeni; but the increased provision of roads is quickly putting an end to this handicap. The benefits of the introduction of increased means of transport, whether by road or by river, are, of course, shown; remarkable examples

of this, affecting other crops before cotton, are an increase in the export of grain in 1928 from Kilwa from a value of £1,084 to £10,829,[15] through the provision of roads; and of rice in the same year from Rufiji, from a customary export of two or three hundred tons, to 2,578 tons,[16] following the provision of roads and regular river and coastal transport services.

Influence of Lack of Economic Transport to Outlets.—Examples of whole provinces that are suffering, or have suffered, from this until recently are Mahenge (including Songea) and Iringa. It is obvious that it can be mitigated for cotton in the early stages, until conditions of transport are improved, by the provision of small, simply-run ginneries turning out half-pressed bales, called "pioneer ginneries" in the Territory. What has happened to cotton through this influence in the Kilombero area of Mahenge is shown in the table given above; at the request of the Administration cotton-growing was introduced, and cotton reported upon as the best from the whole country was produced; but as the carrying of the seed-cotton to the nearest ginnery at Kilosa, and returning, entailed a month's journey, the discouragement was such that the Agricultural Department ceased its efforts. For a similar reason nothing but making recent trials with cotton has been done in the remote district of Songea since the early attempts of one John Booth, interfered with by the rebellion of 1905. It may be recorded here that these trials and the flourishing condition of the semi-domesticated cotton found commonly near native (Wangoni) huts indicate success for cotton; and this success could best be developed early by pioneer ginneries in Songea District and at Tunduru (Lindi) and then (with the general development) by a railway from the Central Line along the Kilombero Valley, eventually to pass round the north of Lake Nyasa to Northern Rhodesia—a railway that would serve the rich areas of the Kilombero and Songea, and the planters in the uplands of Iringa Province as well. As in Mahenge (Kilombero), trials with cotton for natives were made in the middle of Iringa Province; but the produce, though successfully raised, was too far away to reach a ginnery (that from Iringa Province, shown in the table, was from Rungwe [Tukuyu], to be dealt with below). Examples of parts of provinces where cotton-growing has been prevented or has suffered from the above influence are Southern Kigoma (Rukwa Depression), South-western Lindi Province (Tunduru area), and the western part of the Northern Province (area Arusha-Moshi). It is hoped that the first of these, formerly producing cotton for a native spinning industry, showing promise in recent experimentation, and favoured

climatically for cotton[17] by the Germans, will shortly be assisted by the provision of a pioneer ginnery by the British Cotton Growing Association; whilst, as shown above, similar provision would benefit Tunduru together with Songea.

Influence of Unfavourable Conditions.—Altitude obviously has its influence in several parts of the Territory in preventing cotton growing, although under the continental-plateau conditions of Mwanza and Tabora the climate is favourable beneath 3,500 feet. But the great area where conditions are inimical to cotton, through lack of rainfall, is chiefly that comprised by the Central Province (Dodoma). Starting west of the Usagara (Kilosa) System with Mpwapwa, which "lies surrounded by hills with grass-lacking tree steppe, in an unhealthy hollow, devoid of all regional advantages,"[18] this great area stretches away to the west, an ideal cotton protection zone. For this purpose it has been used, to separate the areas having pink bollworm from the cotton lands of Northern Tabora, Mwanza, and Uganda, so far free from the pest. Another area, proved by results and by the experiments of the Department of Agriculture to be unfavourable to cotton, and regarded as such by the Germans because of the irregular distribution of its rainfall,[19] is the coastland of Tanga, where, however, sisal, coconuts, and food-crops can provide ample work and resources for its inhabitants, both native and otherwise. In distinction to these areas, a large part of the Territory is favourable to cotton-growing, as is well known; and there are great areas that only await the pioneer ginnery and transport for their development.

Influence of the Races of Cotton Grown.—It has been well proved, both by commercial results and by experiment (including the German experience and trials noticed above), that Upland cotton is almost ideally suited to the conditions of the Territory. It is a "bread-and-butter" cotton which, while possessing sufficient stamina to withstand native farming, usually gives a profitable return. There are probably, however, races within the type that exist under circumstances that are not the happiest for them, or races that could be isolated to give results that would be better than the present, good as they are. The former of these conditions probably accounts for the circumstance that better yields than those usually obtained are desirable in Mwanza and Northern Tabora, although these are good enough to make cotton-growing worth while. This is why an effort is being made by the Agricultural Department to begin to deal with the matter as quickly as possible by the introduction of races such as U.4 produced by the Empire Cotton Growing

Corporation in South Africa, seed of which has been kindly made available by the Corporation. The second condition mentioned, the possibility of the isolation of suitable district races *in the districts themselves*, forms the principal basis of the work of the Cotton Investigators with which the Department has been provided.

Influence of Inhabitants through their own Conditions.—It is not only inherent backwardness that has delayed cotton production in certain areas, such as Northern and Southern Bukoba (Biharamulo). A far more potent influence exists in the seaboard areas through the well-known demoralization and subversion of their customs that takes place through the coastal contact of indigenous peoples with those who have a different fashion of life. Through this and through the possession of a perennial crop, the coconut, which yields sustenance with little trouble to the possessor or the thief of it, the coastal areas of the Territory (except Tanga which is unsuitable, Pangani which supplies useful sisal labour, and Dar es Salaam which produces food-crops for other areas, as has been shown) produce much less cotton than may be reasonably expected from them. A large proportion of their inhabitants have become economically inferior to the tribes of the interior because they have lost the instinct and custom of raising food and money crops for their own support; Bagamoyo District, for example, actually imports rice for food from Zanzibar, which obtains it from India! It is due to the labours of the District Agricultural Officer, with the usually willing co-operation of the Administrative Officer, that (as in other parts of the Territory) the progress attained has been made.

Effect of the Necessity for Assisting Neighbouring Plant Protection.—An interesting instance of this arose in the course of a scheme for the production of cotton by the natives of Rungwe, the plan being for the cotton to be ginned in Nyasaland; and it is reflected in the entries for Iringa Province in the table given above. Although the seed for this effort was supplied by the Agricultural Department from the Mwanza-Tabora area, free from pink bollworm, apprehension by the Nyasaland Government lest this pest should be introduced into that country with seed-cotton sent over the border to be ginned, caused the scheme to be abandoned. The growing of the cotton produced was, however, very successful; and it may be said that the much more suitable plan of the provision of a pioneer ginnery or ginneries, exporting the lint by way of Lake Tanganyika or Nyasaland, would with reasonable world prices give both the local natives and the exporter the benefit of a very promising industry.

Effect of Control under a Concession Syndicate.—This has not yet been tried in the Territory. It has been examined, however, by Government for two areas of outstanding fertility, the basins of the Rufiji and Kilombero Rivers; and the interesting results of the inquiry are given in the Report on the Development of the Rufiji and Kilombero Valleys of Tanganyika Territory by an Engineer of the Sudan Plantations Syndicate, with comments and a General Note (Rufiji section, Appendix E) by the present writer, which may be obtained from the Crown Agents for the Colonies or from the East African Trade and Information Office in London.

REFERENCES.

[1] Annual Reports of the Department of Agriculture, Tanganyika Territory. (A)
[2] *Bulletin of the Imperial Institute*, xiii., 1915, No. 1. (B)
[3] *Das Deutsche Kolonialreich*, Meyer; Bd. i., 1909. (C)
[4] C, 379.
[5] B, 115.
[6] B, 114.
[7] B, 116.
[8] C, table opp. 397.
[9] C, 382.
[10] B, 124.
[11] A, 1928-29, Pt. I, 23.
[12] A, 1928-29, Pt. I, 36.
[13] C, 104, 109, 112, 116, 164, 198.
[14] A, 1928-29, Pt. I, 24.
[15] A, 1928-29, Pt. I, 18.
[16] A, 1928-29, Pt. I, II.
[17] C, 353.
[18] C, 199.
[19] C, 112.

Received April, 1930.

INTRODUCTION OF AMERICAN COTTON IN THE PUNJAB

BY

W. ROBERTS,

Managing Director, B.C.G.A. (Punjab), Ltd.

The story of the introduction of American Cotton in the Punjab is not as simple and dramatic as would appear from Mr. Trevor Trought's article in July, 1928, in the Empire Cotton Growing Review. The facts are accurately set forth in the Indian Cotton Committee's Report of 1928 (p. 19 *et seq.*). The writer was closely connected with the American Cotton work at Lyallpur from 1909 to 1921, and it is proposed in this article to fill in the gaps in Mr. Trought's account, from the point of view of the agriculturist.

The Agricultural Department started work on American cottons in 1903 at the suggestion of the then Inspector-General, Mr. Mollison. Very little progress was made in the first few years until Mr. A. C. Dobbs started his selections on being appointed to Lyallpur in 1906. During the season 1907-8 he made a large number of selections. On Mr. Milne's appointment as Botanist in 1907 this work was handed over to him by order of the Director of Agriculture, Mr. Renouf. Mr. Milne took over Mr. Dobbs' selections and continued making many others in 1908 and onwards. The arrangement was that promising selections were to be handed over to the Agricultural Section—of which the present writer was in charge from 1909 onwards—for further field tests. It will be seen from the Annual Reports that between 1910 and 1914 about twelve selections of sorts were handed over; these were grown on the Lyallpur Farm both in direct cultivation and with tenants. In 1913 seed for 400 acres of a variety called 3F was put out from the Farm in consultation with Mr. Milligan, who had been in charge of district work from 1906 to 1911 and was still in touch with the work; at the same time the writer put out 100 acres only of 4F. The season proved disastrous to 3F owing to a severe attack of what was then termed "Jassid"—probably now we should call it "White Fly." When the writer returned from leave in October there was general complaint of the failure of 3F, and after inspecting the whole area compensation was paid to growers.

Variety 4F had, however, withstood the attack well and yielded heavily, and it was decided, therefore, from 1914 onwards to push this variety.

The area under American cotton increased rapidly until, in 1918, it had reached 276,000 acres (*I.C.C. Report*, Appendix III., p. 230). The policy of selection being a monopoly of the Botanist, and testing of the Agriculturist, has been criticized, and it is contended in some quarters that the whole of the work should be in the hands of the Botanist. It has even been frequently asserted that 4F was put out to Zemindars years before the Agricultural Section officially issued it, etc. If this were really the case, it shows Government was being fooled in its general policy, and also shows extraordinary vision on the Botanical side, which has not been justified by subsequent independent efforts with variety 285F. This latter variety is described in Mr. Trought's article mentioned above, and was put out in face of adverse reports by the Agricultural Section, of which the writer was in charge up to February, 1921. It has completely disappeared since 1927. It is the firm conviction of the writer that the organization was too narrow, and better and safer results would have been secured if, say, three instead of one Agriculturist had tested the cottons in different parts of the Colonies, instead of merely at Lyallpur. It is gratifying to be able to record that Mr. Trought has from the beginning realized the importance of this and is having his types tested under a large variety of conditions and places. Further, owing to his being able to devote his whole time to cotton work there is a better chance than ever before of getting new types out and tested, whereas both Mr. Milne and myself had many other duties, outside cotton improvement.

What are the main factors accounting for the increase of area of American cotton since 1903*? Has the growing of American cotton been a success?* An attempt will be made to answer these queries below.

So long as seed was imported from Dharwar no great progress was possible. It was only by a process of natural selection through the people keeping their own seed that progress started. There was a bad bollworm year in 1911, but American cotton, of which there was then a few thousand acres only, showed extraordinary resistance, and largely escaped damage. By 1913 and 1914, when we started multiplying 4F with Zemindars, there were large areas grown in Jhang—a distance of over sixty miles from Lyallpur (*I.C.C. Report*, p. 19). The war, 1914-18, when American cotton fetched often 70 to 80 per cent. better prices than the indigenous desi, was another big factor in the spread of American.

Again, public auctions of American cotton—though of little importance in early years, owing to only half a dozen carts turning up—became a big factor from 1913-14. The classification of the cotton by the Agricultural Department and the growth in quantities brought to auction were wonderful advertising factors. By 1918 auctions accounted for 8,000 bales, or 4,000 cartloads of kapas. The history of the auctions is given briefly below (see also Appendix III., p. 230, *I.C.C. Report*, 1918).

	Total Area under American.	*Sale.*	*Premiums.*
1905–08 ..	Under 1,000 acres	Sold by private treaty	1s. per maund of kapas
1908–11 ..	„ 6,000 „	Two auctions annually accounting for 3 to 500 maunds only	1s. to 1s. 8d.
1911–13 ..	„ 15,000 „	No auctions	—
1913–14 ..	30,000, of which 80 acres 4F	950 maunds by auction	1s. 8d.
1914–15 ..	60,000 (4F 3,000)	5,200 maunds (2 auctions)	3s.
1915–16 ..	65,000 (4F 9,000)	8,000 maunds (8 auctions)	3s.
1916–17 ..	125,000 (4F 30,000)	48,000 maunds (9 auctions)	7s.
1917–18 ..	276,000 (4F 125,000)	100,000 maunds (12 auctions)	5s. to 7s.

Auctions were handed over to the Government Department in 1918 and were discontinued shortly after. The total crop reached 1,000,000 acres by 1925, and is still not far off that figure.

Why were Auctions discontinued? (See *I.C.C. Report*, p. 19 *et seq.*, for a fuller account.) The success of the auctions from 1914 to 1918 could not have been assured without the assistance of Mr. O. T. Faulkner, C.M.G., who joined the writer as Associate Professor in 1915, and enabled him to devote more time to district work. Early in 1917 the writer became Principal of the College, and later joined the Indian Cotton Committee. An auction took a large staff the better part of five days—hence twelve auctions took sixty days, and the staff of about twenty assistants were fully occupied with them from early December till February. As the main object of establishing American Cotton was achieved, and it was felt that the Agricultural Department was going outside of its proper function in organizing trade, it was decided to discontinue the auctions Further, owing to the establishment of large grants in the Lower Bari Doab Colony, in 1914-15, the supply of pure seed was assured, hence the necessity of auctions from this point of view no longer existed. The

Co-operative Department probably failed in carrying on through lack of practical knowledge of the trade and of classification, and probably through the increased attack of vested interests. Looking back at some of our recent troubles, notably the increase of mixing of American and desi, it would probably have been sound policy to have persisted with auctions on a smaller scale.

Since 1918 our troubles with American cotton have been mainly of two kinds—viz.:

1. Failure of the crop in 1919, 1921, 1926, and in certain areas in 1927 and 1928; and

2. The mixing of American and desi cotton—a comparatively minor (but excessively advertised) trouble as compared with the above.

It is proposed to deal with these in a subsequent article.

Received May, 1930.

STUDIES ON BLACKARM DISEASE OF COTTON

BY

R. E. MASSEY,
Sudan Government Botanist.

I.—INTRODUCTION.

IN a previous article on the disease of cotton caused by *Bacterium malvacearum* E.F.S., published in Vol. VI., No. 2, 1929, of the EMPIRE COTTON GROWING REVIEW, an account was given of the factors leading to the development of the disease on plants grown from seed which bore the parasite either internally or externally. It was explained that owing to the possibility of seed carrying the infection within the seed coats, control of the disease in the field could not be guaranteed by methods involving the disinfection of the exterior only.

At the time when the note was written transmission of the disease amongst the growing crop from plant to plant, during or subsequent to rainstorms, was recognized, but it was not known over what distance air-borne infection was effective, and if other means existed by which infection might be carried in the field. A perusal of the available literature threw no light on the subject. American writers lay stress on seed-borne infection, and prescribe delinting with concentrated sulphuric acid as a remedy. They are vague on the over-wintering of the parasite either in the soil or on infected plant remains. Workers in the past have described the sensitiveness of the organism to sunlight and to desiccation, and one formed the opinion that the parasite had little chance of surviving outside its host except for a brief period under specially favourable conditions.

As is always the case when a new disease of economic importance appears, the demand for control measures requires the publication of such information as may be gained from limited experimental data. The evidence at hand last season pointed to the seed as the initiator of the disease each season, and the recommendation was made that seed should be disinfected by prolonged heating.

II.—Field Investigations during 1929.

By kind permission of the Sudan Plantations Syndicate, five hundred feddans were sown in August, 1929, with seed which had been dried at 60° C. for twenty-four hours, and subsequently heated at 72° C. for three, five or seven days. In addition, a smaller quantity of seed was supplied from plants grown at Tokar, which area is known to be free from Blackarm disease, and as an extra precaution the crop at Tokar was raised from seed disinfected by heating.

Rains in the Gezira during July, August, and September, 1929, were unusually early and heavy, and were, moreover, rather prolonged. Much of the land was flooded, with the result that conditions were ideal for the development of Blackarm. Observations during the critical period following sowing were impossible, owing to the impassable state of the roads, but when the crop was inspected by the writer in November, no difference in the degree of infection could be detected between the plots sown with heated seed and the remainder of the cotton. It must be added that the treated and untreated plots were never far distant, and no isolated plot sown with treated seed was included in the experiment.

The universality of the disease at once suggested that the seed was not the only means by which the disease was initiated, especially as a re-examination of samples of the heated seed supplied showed that disinfection had been satisfactory. Moreover, bacteriological tests conducted on samples of the seed used in the Gezira last season showed that seed supplied from Kassala was lightly infected only, and that derived from Tokar was clean. Also during the preceding season, *i.e.*, 1928-29, the cotton crop in the Gezira was not severely attacked by Blackarm, and as is customary, the seed taken from this area for sowing in 1929 was selected from the cleanest and best cotton available. These facts made it imperative that the question of the infection of the seed should be examined more thoroughly.

III.—Seed Infection within the Boll.

Two cotton plants which had been heavily infected in the earlier stages, but in which the disease had been somewhat arrested by climatic conditions at a later stage, were examined in detail for the presence of *B. malvacearum*.

The bolls indicated in the accompanying diagrams (see Figs. 1 and 2) were dissected, and examined by plating on to nutrient agar, as follows:—

(*a*) Embryo including cotyledons.
(*b*) Inner seed coats.
(*c*) Exterior seed coats.
(*d*) Fuzz.
(*e*) Lint.
(*f*) Placenta at base, centre, and apex.
(*g*) Boll wall.
(*h*) Receptacle.

The results obtained were as follows:

Plant No. 1. (See diagram.) Boll (1) was found to be infected throughout with the exception of the embryo (*a*). Bolls (2), (5) and (8), were infected basally only, *i.e.*, (*c*), (*d*) and (*e*), of lowest seeds, and of course the receptacle. Bolls (11) and (13) were free from infection.

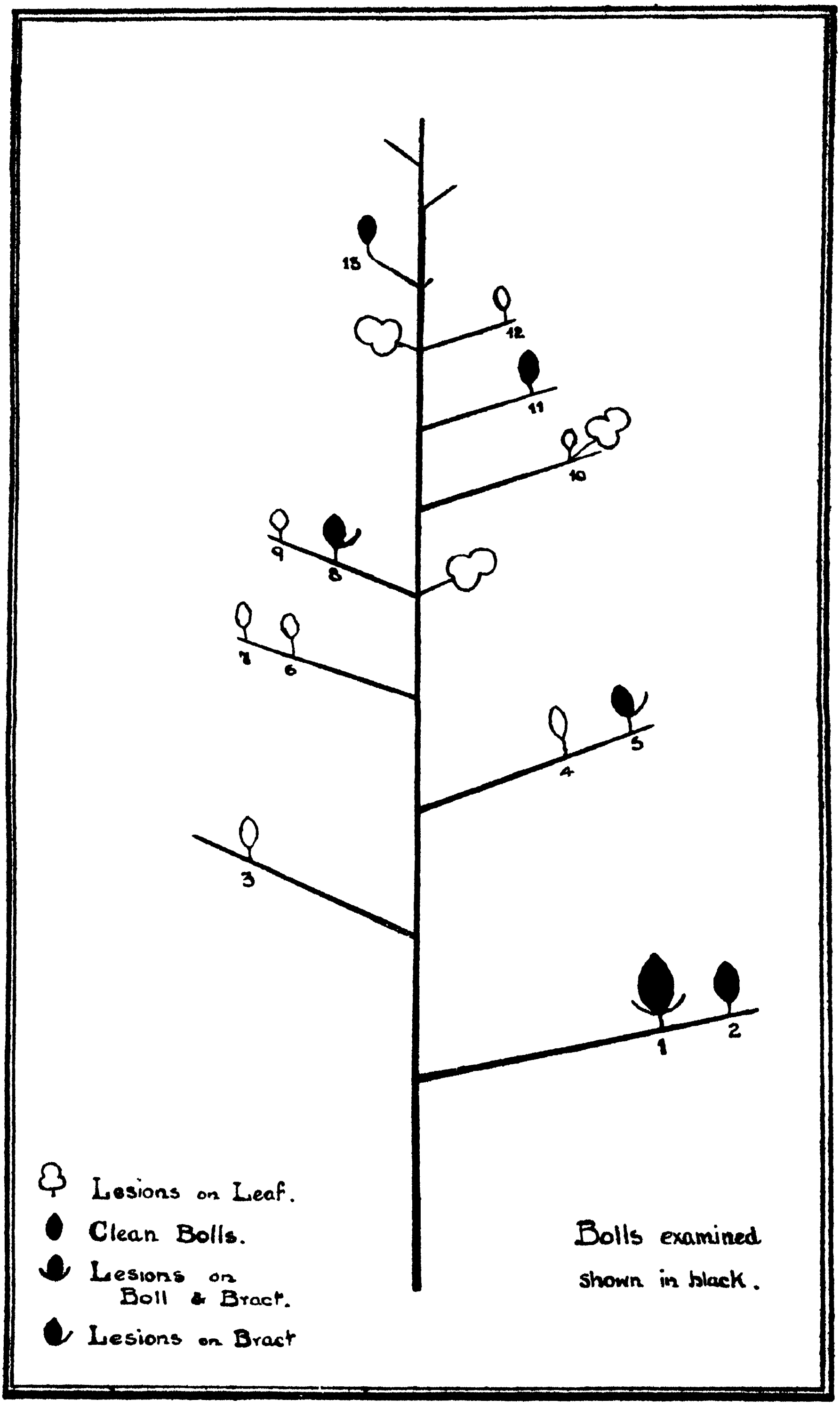
Plant No. 2. (See diagram.) This was more interesting on account of the greater amount of growth. Boll (1) was rejected on account of bollworm damage. Boll (2) was partly open and was found to be rather heavily infected basally, *i.e.*, receptacle and lowest seeds. Bolls (10), (11), (18) and (20) were found to be healthy. Bolls (5) and (13) were infected basally, *i.e.*, (*h*) and (*c*), (*d*) and (*e*) of lowest seeds only. In addition, the stem of plant No. 2 was examined at the points marked A, B and C on the diagram, but the lesions were dry, and *B. malvacearum* was not recovered.

Simultaneously with the above, large numbers of green bolls in all stages of development were obtained from the Gezira, Kassala and Shambat, and were examined in detail. The results may be summarized as follows:

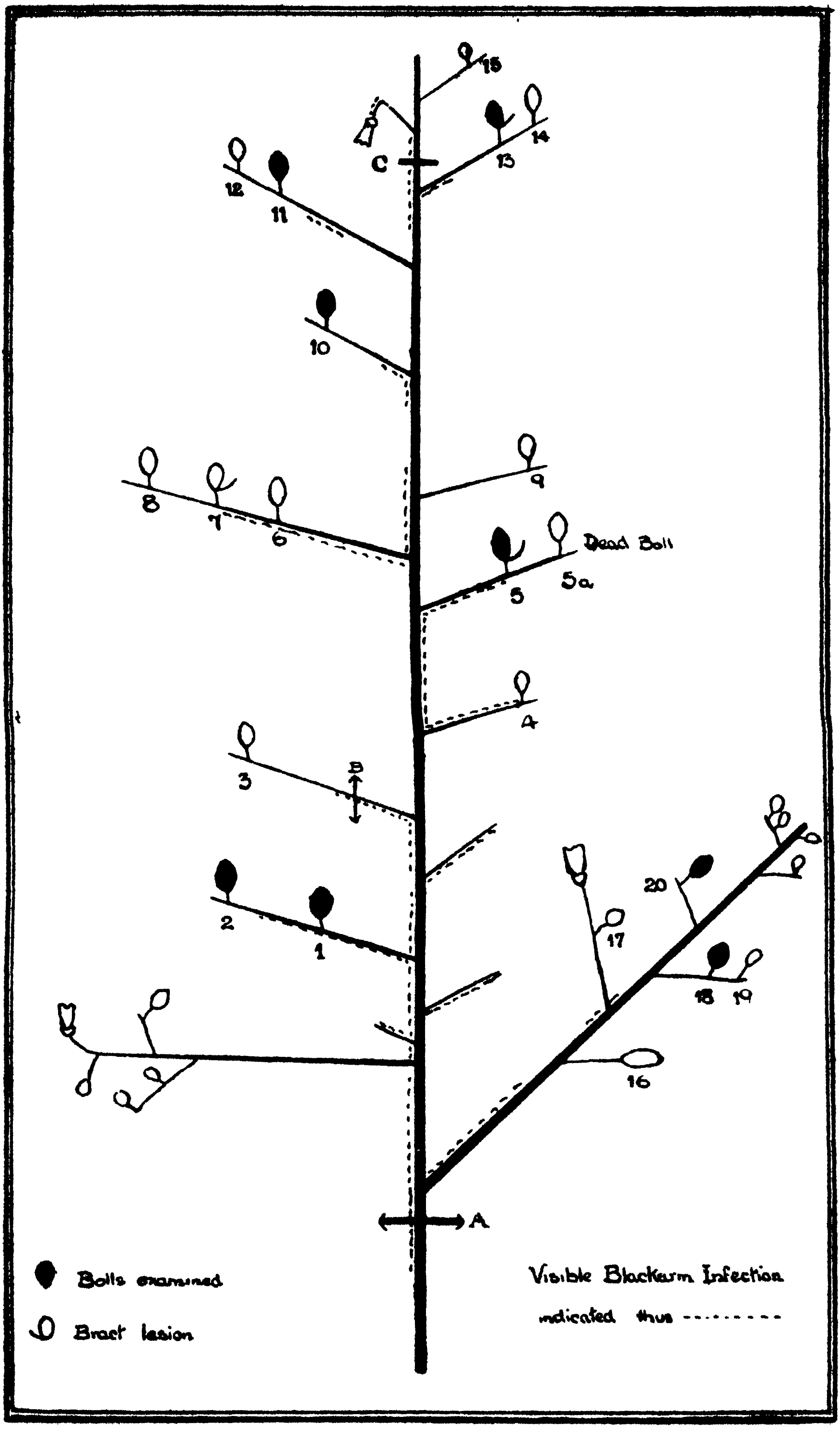
(*a*) The presence of a lesion either on the boll itself or on the receptacle is necessary to infection of the boll contents. The size of the lesion is no indication of the extent of the internal infection.

(*b*) If a lesion is present on the boll wall, the contents beneath the lesion are infected, but it does not follow that the infection of receptacle (base of the boll) will lead to infection of the boll contents, though generally the extreme tip of a lock is infected by the intrusion of slime from the receptacle into the body of the boll. The infection within a boll may be strictly localized.

(*c*) The commonest route for the parasite is via the superficial tissues of the receptacle into the bracts and the boll walls; only in the case of a severe infection is the placenta invaded. This is doubtless connected with the food supply, for the base of the boll is full of sugars, and possesses large glands around which the parasite centres. The lint and fuzz are only infected by contact with a lesion.


13
12
11
10
9
8
7
6
5
4
3
2
1
Lesions on Leaf.
Clean Bolls.
Lesions on Boll & Bract.
Lesions on Bract
Bolls examined shown in black.

PLANT No. 1.


15
14
13
C
12
11
10
9
8
7
6
Dead Boll
5
5a
4
B
3
2
1
20
17
18
19
16
A
Bolls examined
Bract lesion
Visible Blackarm Infection
indicated thus

PLANT No. 2

(*d*) Consequent on (*c*), external infection of the seed is the commonest phenomenon; internal infection only takes place when the boll is badly infected. It has not been demonstrated this season (1929), though it undoubtedly does occur, and must always be reckoned with.

(*e*) In bolls infected basally only (*i.e.*, the receptacle), only the basal seeds are involved, the uppermost seeds being free.

(*f*) In an infected plant, the infection appears to die out to a great extent in the old dry lesions, and to concentrate in young developing bolls.

The organism can generally be recovered, frequently in association with other microbes, wherever there is slime, or where the lesion is at all moist.

As at Tokar, growth of the parasite may be entirely arrested and the infection remain in the basal portion of the plant, the upper parts being free. The extent and the character of the infection depend on climatic factors. The truth of this was demonstrated in the Gezira during the present season, when, as the direct result of altered weather conditions, a severe Blackarm infection was arrested and abundant new growth formed in which the disease made little progress.

It follows, from the investigations described above, that bolls bearing no lesions whatever may be expected to produce clean seed, an observation which should be of value in connection with the supply of seed for sowing.

The presence of lesions suspected to be due to *B. malvacearum* can be confirmed by disinfecting the bolls thoroughly on the exterior, cutting with a sterile knife, and incubating at 20-28° C. in a sterile glass vessel containing a little sterile damp cotton-wool. The characteristic yellow slime will appear after a few days on the site of the lesion, if *B. malvacearum* is present.

Before leaving the question of the seed, it is necessary to add that the ginnery may be a potent distributor of infection. Dust from the previous season's work has been found to carry the parasite after seven months. Moreover, it was found possible to infect a sample of clean seed by passing it through a roller gin immediately after ginning a consignment of cotton infected with a small amount of bacterial slime. It is possible that the disease may be introduced into new areas by this means, even when it is believed that seed from a clean crop has been provided.

It seemed likely at this stage that the seed sown in the Gezira during the season 1928-29 was not entirely responsible for the outbreak of disease in July and August, 1929, and that other means of infection existed.

IV.—The Survival of B. malvacearum within Plant Remains.

An inkling as to the ability of the organism to withstand desiccation and heat was obtained when debris, already five months old, was collected from amongst the growing crop, and examined for the presence of living *B. malvacearum.* Visible growth was obtained on agar within twelve hours, and virulent cultures were obtained with ease. This observation has been repeated many times and applied to dead leaves, stems, and bolls, and whilst the parasite could not be guaranteed alive in dead leaves and stems, it was invariably recovered from old bolls, and from the slime-covered lint within such bolls. It was frequently possible to infect cotton seedlings by soaking old infected debris and inserting it into the stem.

Proof of the resistance of the organism in the dry resting stage to high temperatures was obtained by heating debris in an electric oven. It was found that on infected lint *B. malvacearum* would withstand a temperature of 72° C. for thirty-six hours, but was dead after heating for forty-eight hours. In old bolls, however, the parasite was found to survive and retain its activity after seventy-two hours at 80° C. Exposure of debris to sunlight on a hot cement roof for two months left the vitality of the enclosed organism unchanged.

V.—The Survival of B. malvacearum in the soil.

Attempts to isolate *B. malvacearum* from the Gezira soil have met with failure, except in association with plant remains. The following experiments were therefore planned to throw more light on the question of the survival of the organism in the soil.

(*a*) Raw Gezira soil, and Gezira soil partly sterilized in the autoclave, were heavily sprayed with a suspension in distilled water of *B. malvacearum* obtained from agar slopes. Half of the series was left in the incubator and the remainder was placed on the roof in full sunlight.

Result.—After forty-eight hours *B. malvacearum* was isolated from both series. After three days, by which time the soil on the roof was air-dry, *B. malvacearum* was not recovered from this series, nor was it recovered from the unsterilized soil in the autoclave, but it was isolated from the sterilized soil.

(*b*) Three series of large dishes containing (1) Gezira soil sterilized in the autoclave; (2) Gezira soil treated with toluene; (3) a control consisting of Gezira soil, were inoculated heavily with a suspension of *B. malvacearum*, as in Experiment (*a*), and incubated at 24° C.

Result.—After five days *B. malvacearum* was recovered from (1), (2), and (3). After fourteen days the parasite was not recovered from any of the dishes. The soils were still moist.

(*c*) Large pots were filled with Gezira soil mixed with unbroken infected debris, and were buried in the soil to ground level. Half of the pots were kept moist and half dry. All were in full sunlight.

Result.—Bacteriological examinations were made monthly, with the result that *B. malvacearum* was not recovered at all from the wet decomposed debris, but was found to be alive in the dry bolls, and on the infected lint contained therein.

(*d*) Clean seed which had been disinfected by heating at 72° C. for seven days was sown in the Gezira by Mr. A. R. Lambert in January, 1930, on fallow land, along with seed delinted by treatment with sulphuric acid.

Result.—A few seedlings showed watery lesions in due course, in spite of the fact that January is not a suitable time for the development of the disease.

(*e*) A small plot of virgin soil isolated from any cotton was sown by Major R. G. Archibald, C.M.G., D.S.O., Director of the Wellcome Tropical Research Laboratories, Khartoum, in July, 1929, with cotton-seed which had been disinfected by heating, and a similar small plot adjacent to it was sown with untreated seed.

Result.—Both plots were severely attacked by Blackarm disease in the following August, and bolls and leaves were shed. In January, 1930, the cotton was cut out, and after a short interval heated cotton-seed was sown in both plots, with the result that many of the seedlings exhibited lesions from which *B. malvacearum* was recovered. In this instance the parasite was also recovered from the surface soil.

(*f*) Sterilized river water, sterilized mud, raw river water, and unsterilized mud were inoculated with *B. malvacearum* from cultures, and incubated at 24° C. in the incubator.

Result.—The organism was recovered from sterilized river water after one month, and showed no signs of loss of vigour, but it was lost after a few days in sterilized mud, and also in unsterilized water and mud.

(*g*) Media were prepared, using river water, and also a filtered extract of soil made with river water, peptone, glucose, and agar being added in the usual proportions. The final reaction after sterilization was 8·2 pH in each case.

Result.—*B. malvacearum* grew freely and developed rather more pigment than on nutrient agar.

Bacteriologists will appreciate that it is extremely difficult to separate a comparatively rare plant parasite from the welter of micro-organisms living in soil or river water. Doubt was cast, moreover, on results obtained in the laboratory by the discovery that under certain circumstances a form exists sufficiently small to pass through Chamberland L3 filter.

It has been known for several years that *B. malvacearum* undergoes a reduction in size in old cultures both on solid and in liquid media, and that rod forms are replaced by coccoid bodies after a few days' incubation. Recently, however, a filtrate obtained by passing a three-weeks-old culture in peptone glucose broth through a Chamberland L3 candle has been injected into the leaves and stems of young cotton seedlings, with the result that watery lesions have formed in a few cases from which the characteristic rod form has been isolated, and proved to be *B. malvacearum* by transmission to other plants. The experiment has been repeated three times, and in each case a few lesions have been obtained. The lesions were small and slow in developing; considerable trouble was occasioned by the falling of inoculated leaves, due to the toxic effect of the filtrate. Should this minute form occur in nature, the usual bacteriological methods adopted for the examination of soils would fail to indicate its presence, owing to the rapid growth of the normal bacterial and fungal flora.

VI.—Various Characteristics of B. malvacearum.

Proof has been given of the great powers of resistance to desiccation and heat possessed by *B. malvacearum* in the resting stage; it now remains to record a few observations made on the actively-growing organism which demonstrate its adaptation to environmental conditions at the time when the disease is rapidly spreading, *i.e.*, during the rains.

Bright sunlight has always been supposed to exert an inimical effect, but recent tests have shown that in river water, or in a filtered watery extract of Gezira soil, organisms taken from a leaf lesion have retained their vitality unimpaired after six hours' exposure to bright sunlight, provided that the suspension was kept below the thermal death point.

By means of a warm stage heated electrically, it was ascertained that motility in a hanging drop was not affected when the temperature of the slide reached 40° C. (104° F.), which is warmer than the temperature of the air in the Gezira after rain. Hanging drops of the organism showed active motility after standing three days in

the laboratory, and what was more striking, hanging drops dried in the incubator at 36° C. showed motility afresh when distilled water was added.

As regards the resting stage in slime and debris, motility appeared after a short interval, never longer than thirty minutes, when infected material was soaked in water. It is simple to ensure that one is dealing with *B. malvacearum* in such tests, by using lint from an unopened boll, or by dissecting particles from the interior of an infected boll receptacle.

B. malvacearum is essentially a moisture-loving organism, and many of the apparent discrepancies met with are due to this fact. It was noticed that growth on agar practically ceased at 36° C., while definite growth was obtained at 37° C. in broth, but not on solid media. This is one of the points in which variation has been noticed in different strains.

Everyone familiar with Blackarm disease in the field knows that the parasite makes greatest headway in succulent, water-logged plants, and that its progress is retarded by water shortage. It is hoped to consider this and kindred subjects in another paper.

VII.—Bacteriological Technique.

Details of the technique employed in the investigations outlined above have been purposely omitted, as they tend to obscure the main points. It will be sufficient to add that standard methods were used throughout. Various media have been tried in the past, but eventually Bacto dehydrated nutrient agar, standardized to 6·8-7 pH, was adopted.

MacConkey's agar (also Bacto brand) was used sparingly in connection with soil examination. Soil extract agar was found useful, as pigmentation was good. It was prepared by extracting Gezira soil with river water, filtering, and adding 1 per cent. peptone, 0·5 per cent. glucose. The final reaction was 8·2 pH.

The tedious process of the examination of single cotton-seeds was shortened by grinding samples to a fine powder in a sterile enclosed mill, and plating aliquot portions by the dilution method.

Plants required for inoculation purposes were raised from seed which had been heated for five or seven days at 72° C., and subsequently delinted with sulphuric acid.

No organism was accepted as *B. malvacearum* until its identity had been proved by inoculation into plants, with the subsequent production of the characteristic lesions.

The writer desires to acknowledge the help received from Mr. M. C. Hattersley throughout the work.

VIII.—Summary and Conclusions.

1. The failure of seed disinfection to inhibit the development of Blackarm disease of cotton in the field has led to the examination of other possible means of infection.

2. It has been found that *B. malvacearum* can survive in dry debris for a relatively lengthy period. The parasite, moreover, is highly resistant to drought and heat in the resting stage within plant remains.

3. The survival of *B. malvacearum* in the soil for any length of time is doubtful, apart from debris. It can, however, survive in river water for several weeks.

4. The existence of a filter-passing stage has been demonstrated, but it is not yet known if this form occurs in nature.

5. The relation of boll infection to the contained seed has been studied, the main conclusions being that clean bolls produce clean seed, and that severe infections are necessary before the interior of the seed is invaded by the parasite.

6. Finally, it is considered that once the parasite has gained admittance into a cotton-growing area, the problem of its persistence between seasons on infected tissues must be faced, wherever a dry fallow exists. It is believed that the reappearance of the disease in areas in which clean seed has been sown is largely attributable to the carrying-over of the infection from the past season.

Experiments have been planned for the coming season which will enable us to estimate the relative importance of the various methods of infection in the field, at the conclusion of which it is hoped that measures for the control of the disease may be more effectively considered.

Received April, 1930.

SOME BROADER ASPECTS OF COTTON BREEDING

BY

C. H. BROWN, B.Sc.

(Botanical Section, Ministry of Agriculture, Egypt).

COTTON breeding which aspires to be more than routine work requires from the men in charge a certain breadth of outlook on the many aspects which have to be co-ordinated one with the other. The following hints, based on the writer's experience in Egypt, may be of interest or even of profit to workers in other fields. In Egypt we have well-equipped and staffed cotton-breeding labs and farms, with an organization for seed-distribution of selected strains which works fairly well, in spite of the difficulties of an uneducated population. Under these conditions the breeder gets down to the finer details, and is obliged to do some intensive thinking into the real cotton needs and prospects of the country.

The main problems divide themselves into:

(*a*) Agricultural.
(*b*) Economic and general.

AGRICULTURAL PROBLEMS.

At the root of the agricultural problem, more especially when propagating different varieties in different districts, is the difficulty of sorting out the interlocking effects of soil, watering, manuring, and cultivation. The usual practice in Egypt up to now has been to carry out variety tests as far as possible on typical soil under typical cultivation conditions. In actual fact, however, it is generally found that farms chosen for experiments are cultivated better than the average. The root difficulty is to know how far the results obtained on one farm really do represent the average of the locality. The variety of the reactions of which the cotton plant is capable has to be seen to be believed. In the same climatic district different soils, water-tables, or manures can produce quite varying effects on different varieties. Propagation of different varieties for different soils or for different manuring practices being impossible, the only divisions possible are into climatic zones, and it therefore becomes important to analyse as completely as possible the varied results exhibited in each zone, with a view to striking the best possible average. As instances of

the climatic effects met with, Giza 3, a long-staple Upper selection, when grown at Giza was relatively later than Ashmouni, but it has since been found, in the southern districts of Upper Egypt, to be relatively earlier. Earlier and later are here used in the sense of the arrival of the crop; flowering counts show that in all districts Giza 3 gets away later in its flowering than Ashmouni, its advantage in its own district being entirely due to a capacity to hold the early bolls while Ashmouni sheds them. Giza 7 also shows marked difference in reaction to manuring, in some districts overgrowing on the slightest provocation, and in others having a short-growing habit which can successfully carry heavy nitrogenous manuring. These and similar cases have proved in Egypt the absolute necessity of giving every likely-looking type a trial in all districts. It appears quite impossible to forecast from any one district, even if central, as at Giza, what a cotton will do in others. Generalizations such as the opinion almost universally held in Egypt up to now, that the Delta is peculiarly suited to long-staple cottons and Upper Egypt to short-stapled, are very much more of a hindrance than a help.

Refinements of testing work come in when some change in general practice is taking place, as in the increased use of nitrogenous manures in Egypt. Here the breeder's best line is to guess at what is likely to be the average practice in two or three years' time, and to carry out his tests on this basis. The matter is rather more difficult when the breeder thinks that a general change in practice ought to take place, and has perhaps shown by experiment that it would be desirable, but the cultivators show no signs of adopting it in general for the immediate future. Such a case arises in Egypt, where we have experimental evidence that the first waterings could advantageously be given at shorter intervals than the usual. Again, the fundamental trouble is that there is no certainty that the order of merit of varieties will be the same under the different treatments, and often there is definite evidence that it will not. For example, in Egypt in 1929 five varieties were grown in the Delta—(*a*) under normal treatment, (*b*) with extra nitrogenous manure and the increased early waterings mentioned above. The results showed, on the average of the same experiment for two farms, that the atypical treatment increased the average yield by 280 lbs. of seed-cotton per acre. The order of merit was, however, altered, variety A being top in the typical treatment, but variety B showing potentially higher yield and coming out top in the experimenters improved conditions. Here is a real dilemma, and the only satisfactory solution is, while leaving A in general cultivation, to induce selected cultivators to grow B with the treat-

ment by which it has been shown to be able to outyield A, in the hope that the results may be sufficiently good for all cultivators to be willing to take B in place of A with a change in cultivation methods.

This instance is very typical of the way in which a cotton breeder has to keep in touch with the agricultural conditions, and the changes in them, and often keep a leg in both camps, new and old, with a cotton up his sleeve for either. Then if the territory in which the breeder is working has two different climatic zones, it may be that the desirable change in cultivation methods is in different directions for each zone, requiring possibly four cottons—two for present conditions, and two for the hoped-for change. This may seem over-elaborate, and, with limited resources for seed-breeding, may not be possible, but it is undoubtedly necessary if the maximum yield is to be obtained under all conditions.

In Egypt we have four fairly distinct climatic zones, and our present idea is that not less than eight to ten varieties will be permanently necessary to get the best possible results in both yield and staple for all districts. This need not involve such a complexity of work as it appears to do. The most important thing in breeding is to have an efficiently working testing machine, it being always remembered that comparable material for all forms of testing, including grading and spinning, can only be obtained from some form of chequer plot. In Egypt we carry out "miniature chequers" for analysis of yield by flowering and boll-counting, boll weight and ginning out-turn records being also taken, in five localities. These comprise about thirty strains, and the most promising are included in full-size "yield chequers" in twelve or more localities, each comprising about six strains. This involves a minimum of detailed descriptive field notes on the breeding plots, as anything which shows signs of being in any way promising can be included in "miniature chequers." The testing of so many strains requires that their purity in the early stages be not too meticulously insisted on, as this would make the work prohibitive. The methods of genetic research, with its field examination of plant by plant for vegetative characters, are really quite out of place in breeding for economic results, though there is an unfortunate tendency to confuse the two. Anything which roughly appears to be sufficiently of a type to give comparatively consistent yield and staple results may be put into the early stages of testing. Concentration on an efficient testing machine giving reliable indications for yield and quality, which are, after all, the only final considerations, will give much greater results for the same amount of work than the field-examination methods commonly used. As strains are tested in this

way they can be tentatively propagated up to about 10 acres each. Seed from a good many such 10-acre plots can then be held in reserve, each strain having been tested and its potentialities roughly known until circumstances call for its propagation.

As an instance of the following of rule-of-thumb methods on set lines, it may be mentioned that, while the breeder is constantly adjured to look for the sympodial cotton plant and to discard monopodial types, one of the best yielding types ever selected in Egypt is a plant starting off with strong monopodial branches. Its merit lies in the fact that these are sufficiently low on the stem to fruit almost as soon as the main branch, yet it is a type that the majority of breeders would have discarded at sight.

Having obtained from such a testing machine as mentioned above a variety of types, those not at the moment required can be held up by storing the seed, while those required can be propagated and at the same time purified. For purity work a special purity chequer of 100 plants can be examined by target methods, and nucleolus selections made from the type group to form the original material for propagation. Such technique is pure rule of thumb, but it is a more stringent test for gametic purity than any ordinary genetic procedure. It is fortunate that such is the case, because our system of seed-renewal is mainly dependent on the purity of the nucleolus stock giving it stability over many years. Our propagation machinery in Egypt starts with a bee-proof cage, for which some new stainless steel wire gauze, made of Messrs. Firth's "staybrite," is particularly convenient. Seed resulting from this goes out into a system of contracts with growers, each contract corresponding to one generation of the renewal stock. These are designed to give successively looser control on larger areas. By contract A, generally at present a 10-acre area, the seed-cotton is bought back and ginned at Giza. By contract B and C the seed only is bought back, in the case of contract B all the seed, in the case of C all except that which the grower requires for his own use. Contract D is a ginner's contract, the contractor being required to return the same quantity of seed as that taken, the remainder being his unrestricted property. The seed returned from this is used for distribution to small growers on credit. At this stage it is assumed that the seed is contaminated, and the law by which all seed sown has to pass a fixed standard of purity is designed to prune away the impure seed as successive waves of purer seed come on from the pure source. The renewal idea is here much more important than attempts to guarantee purity on a large scale, which is generally almost impossible. Of course, when a variety is

covering 1,000 acres or so, in a continuous block of cotton, the renewal may be made from the "nucleus stock" in the centre of this area, only returning to the true cage-grown nucleolus at intervals of some three years; in this way the capacity of a given area of caging is trebled.

Economic Problems.

In the present crude state of economic understanding in most undeveloped countries, and in some more developed, every cotton breeder is more or less bound to be his own cotton economist if he is to work intelligently. It must always be remembered that, in our world as at present organized, cotton is grown to be sold, and not, as is sometimes suggested, to be spun. Two lines of study are therefore essential. The more simple of these is the relative profit to the grower of alternative crops and of cotton at various yields and prices. The more fundamental is the study of all the staple and price possibilities of the cotton of the country. There are unlimited possibilities here for the development of cotton and economic talent because the cotton must be followed up into all its present and potential uses, and the conflicting voices of would-be advisers are legion. Cottons sold at a premium over American are more difficult than American types, because not only do basal prices vary, but the percentage premiums obtained fluctuate too, often most erratically. In Egypt, with Ashmouni and Sakel sometimes at a seven dollar difference and sometimes at twelve, a cotton with an intermediate staple finds itself in positions of varying degrees of precariousness and security. Here, again, the only safe line, where different varieties are shown as the most profitable according as premiums vary, is for the breeder to study the maximum fluctuation in premium, and have cottons ready for either case. It is, of course, always possible that the market may, in the future, settle down permanently at a figure which, in the past, may have been extreme. For instance, in Egypt an almost continual lowering of the percentage premiums on American is being experienced, due to relatively larger crops. For small areas the breeder's own varieties will of course have no effect on the general market, but for larger areas they may do so, and these possible effects must also be considered. The breeder will generally be offered a variety of advice from graders, merchants, and spinners. All this advice requires careful study and an appreciation of the truth behind it, but in the last resort the breeder is generally obliged to form his own conclusions.

The above general remarks assume that a new cotton has found,

or is in process of finding, its true economic level on the market. But this acceptance of a cotton at its true value is by no means a foregone conclusion, and often a great deal of work has to be done in the direction of "making straight the paths." The more rapidly a cotton is being propagated, the greater is the need for an intensive preparation of the ground for its marketing and use. In so far as an improved cotton has a greater money value per acre, this can either be left entirely to the benefit of the grower, in the case where the cotton fetches its full relative value, or entirely to the benefit of the spinner, if he is given the full benefit of the cheapening which the increased value makes possible. In the early stages of a cotton, the breeder will be able to have some control over the price at which the cotton is offered to the spinner, and it will generally be found profitable to the grower in the long run to let the spinner have the major part of the economic inducement. A feeling among spinners that it is not worth while changing over to the use of a new cotton may be very difficult to eradicate, and must at all costs be guarded against, while, on the other hand, the growers will generally be more easily persuaded to "take what is good for them." At all stages, the breeder has an advantage if he is familiar with all the processes of ginning, merchanting, and spinning.

Received April, 1930.

GINNING TECHNIQUE AND COTTON QUALITY

BY

HORACE SPIBEY, M.Sc. Tech.,
College of Technology, Manchester.

PART II.

The removal of the ginned cotton from the saw-teeth is an operation of great importance to the quality of the ultimate lint, and within recent years ginning practice has shown a preference for the air-blast system of stripping the saws, in place of the older method of brush stripping. Saw gins are at times classified according to the method of stripping as brush or air blast.

Brush Gins.—The brush system is the original method, and much attention has been devoted to rendering its action more effective, and making brush replacement, and setting, more expeditious and easy. The method of securing the bristles into the hard wood lags, for example, has been the subject of much experiment, as also has the mounting of the lags, which are now usually made to be withdrawn endwise from the cast-iron discs which carry them. In this way the renewal of worn brushes is greatly facilitated, and the time lost in replacement is considerably shortened. Furthermore, the drives to the brush and saw shafts are usually arranged so as to be independent, the advantages being that alteration in speed is easily effected, and a more efficient brush drive obtained. It is also advisable, when stopping the gin, to stop the saws first, and on restarting it the brush must be started first. To obtain these conditions, independent driving to these two principal parts must be arranged.

The number of rows and the length of the bristles vary with different gins, the average number being twenty-two to twenty-four, and the length usually varying from 1 to 1¼ inches, to give a brush diameter of 15 to 15½ inches. In the operation of the brush gin, the brush is first set up to the saws so that the tips of the bristles overlap the saw-teeth to the extent of $\frac{1}{32}$ to $\frac{1}{16}$ inch, or in some cases even more. The relative peripheral rates of brush and saws also form a varying factor, and under different conditions it is found that the brush surface speed fluctuates from 4·5 to 6 times

that of the saws. Too low a ratio causes unsatisfactory and dilatory stripping, with its attendant evils, and too high a ratio creates excessive wear at the brush, with perhaps the possibility of stringing and nepping. Although satisfactory stripping at this point is the prime essential, the function of mote extraction is of no mean importance, and provision is made for this by the inclusion of an adjustable mote plate or board, K (Fig. 1, see p. 113 of this Review), located below, and between, the saw cylinder and brush. The air current, generated by the revolution of the latter, is directed on to the saw-teeth by a division plate, H, mounted above, and between, the saws and brush, the blast thus induced being partially, or completely, responsible for the removal of the lint. At the same time, by suitably placing the mote plate relative to the brush, some degree of separation of motes and cotton is effected by the former falling out of the path of the lint, which is blown into the flue. The setting of the division and mote plates will be the most influential factor in deciding the thoroughness of the mote extraction, to facilitate which the mote plate is provided with a wide range of adjustment to suit varying conditions. In minimizing the creation of neps and stringing, the brush stripping plate L (Fig. 1) plays an important part. This plate or board, mounted at the rear of the brush, is set as close as possible thereto, without, however, making contact, in order to prevent the lint from following the path of the bristles, and thus being carried round and "tailed." The distance of the plate from the brush is, of course, adjustable, and as wear occurs, provision is made for resetting the plate accordingly. Unfortunately, advantage is not always taken of this facility, with the result that nepping and excessive stringing occur.

The limitations of the brush system of stripping have long been recognized, although within the past few years the development of the air-blast method has caused greater emphasis to be placed on them. The principal, and unavoidable, defect is the continual wear which takes place at the brush. Its high surface speed and wiping action on the saw-teeth cause, after some time, a shortening of the bristles to such an extent that eventually there is no contact whatever between the two parts, and the action of stripping, therefore, becomes primarily dependent on the air blast generated. Herein lies the necessity for periodic supervision, to ensure that wear at the brush is adequately compensated by a readjustment of its position in relation to the saw-teeth. Unfortunately, this constitutes one of the commonest sources of neglect, and gin-cut, stringy, and neppy lint is prevalent, in varying degrees, in the final out-turn.

The influence of brush condition on the saw speed, also, is worthy of mention. It is quite a common belief that a high speed of the saws will cut the lint. Investigations, however, have shown this to be incorrect, provided that the saws are in good condition, that a correct roll density is maintained, and that the lint is promptly removed from the saws and not allowed to pass through the gin ribs a second time. The speed of the saws, in theory if not always in practice, is limited by the ability of the brush to remove the lint from the teeth. If, therefore, the brushes are in bad condition, the saws must run at a slower rate. For brushes in good condition, it has been found possible to run at 380 r.p.m. for 12-inch, and 400 r.p.m. for 10-inch saws, for the maximum speed. A further limiting influence, on high saw speeds, is the surface speed ratio of these two main parts. It should be remembered that the surface speed of the brush must be approximately four to five times that of the saws, which means that with the latter running at 380 to 400 r.p.m., the former must rotate at about 1,600 r.p.m.—a speed which is very high for such an instrument, and one which cannot be maintained satisfactorily for long, especially if the brush is set too deeply into the saws.

Air-Blast Gins.—The discovery that the air blast induced by the brush was sufficiently powerful to influence the removal of the lint from the saw-teeth, is supposedly responsible for the adaptation of the pneumatic principle to the saw gin, thus making a machine which undoubtedly possesses many advantages over its predecessor, the brush gin, and which, within recent years, has been brought into greater prominence and application. One form of this machine, furnished with a huller box, is shown in Fig. 2.

The location of the moting point is probably the most distinguishing feature of the various types of air-blast gins. In one case the motes are discharged below, whilst in another they are discharged over the top of the air lip. The relative advantages of these two main types have often been debated, and the possibility of motes returning to the lint freely discussed. Criticism is sometimes levelled at a construction in which the cleansing point is situated above the stripping point, and the placing of the latter in what is often regarded as the path of the discharged impurities has occasioned adverse comment. Nevertheless, it does not appear that this mode of construction has in any way influenced the popularity of this type of gin. The design and position of the nozzles in the two machines is shown in Fig. 3, the discharge opening, after much detailed investigation, having been reduced to $\frac{4}{16}$ or $\frac{5}{16}$ inch. The

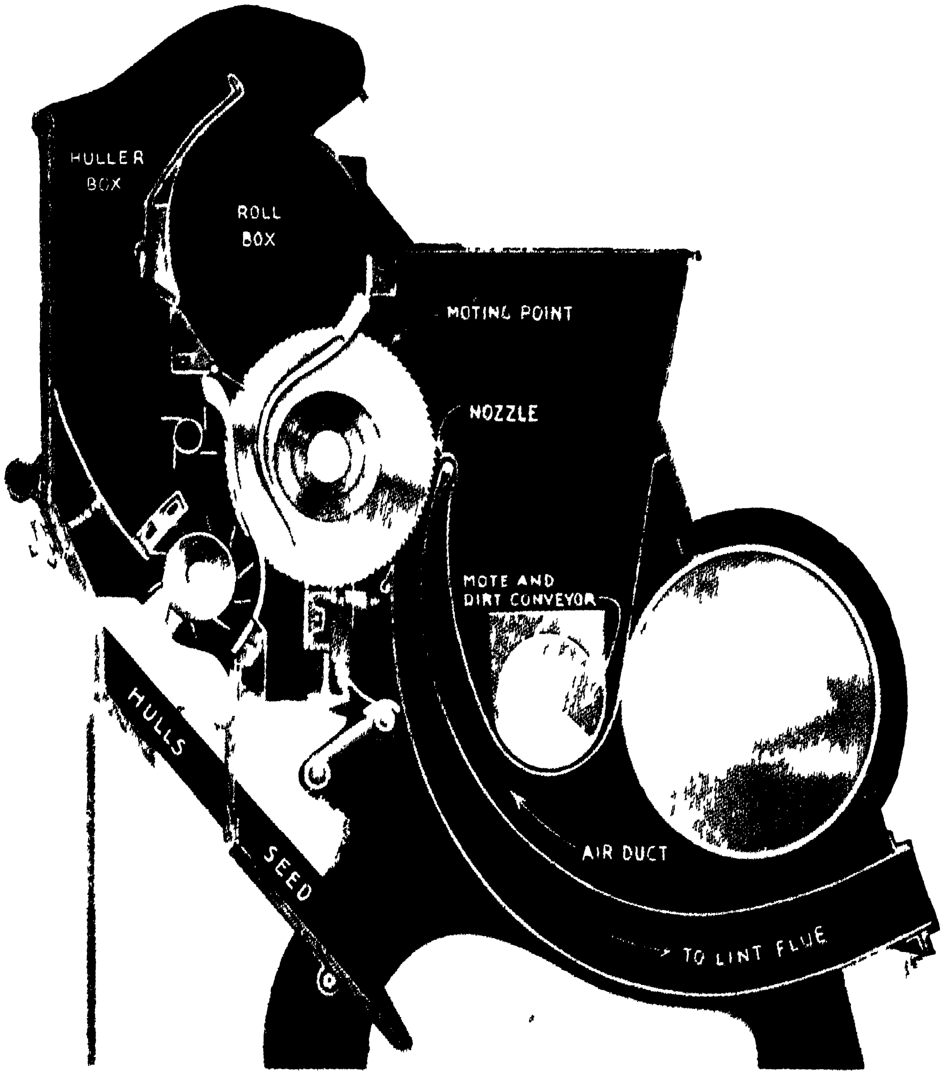


FIG. 2.—SECTIONAL VIEW OF AN AIR BLAST HULLER GIN.
Note location of air nozzle, moting point, and mote conveyor

proximity of the lint flue sheet, A, to the saws has, likewise, been the subject of experiment, and ordinarily is brought up to within $\frac{1}{32}$-$\frac{3}{32}$ inch of touching the saw-teeth. The entrance of the lint flue is designed to be capable of receiving all the air discharged from the air nozzle, and, in addition, a weak stream of external air caused by the dynamic action of the air from the nozzle. In this way loss of lint is prevented, the weak air stream, induced by the main air current, usually being sufficiently powerful to counteract any tendency for lint to deviate from its course to the lint flue entrance. The recording of the pressures of the air streams around the stripping point has been undertaken, and much valuable information derived to form the basis of modification of nozzle design.

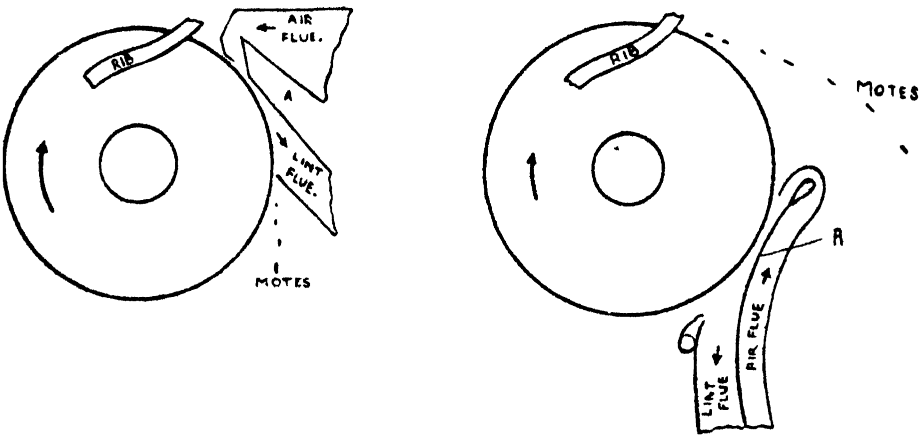


FIG. 3.—AIR-BLAST SYSTEMS.

The advantage of the air-blast system as against the brush gin is shown by the favour which has recently been accorded to it, not only in the United States, but also in the newer cotton-growing areas within the Empire. Probably the greatest asset of this type of gin is its capacity to function efficiently at high speeds and give a greater out-turn than a brush gin of a corresponding size—a speed of 700 r.p.m. of the discs being by no means uncommon for a standard 80-saw machine, with 12-inch discs.

At this stage further reference may be made to the effect on lint quality of such high saw speeds as are attained on this type of gin. Practice has shown that the density of the feed roll exercises much influence on the relation of saw speeds and lint quality, and it is important to note that a high speed—500 to 700 r.p.m.—with low density feeding, will ordinarily cause less damage to the cotton than a speed of 250 to 300 r.p.m., with high density feeding.

Other features of the air-blast gin which appeal to the ginner

are its simplicity and lower cost of maintenance. Working, as it does, with a loose or low density roll, the power consumption is appreciably reduced. The question of production and power consumption is of much importance in ginning, and for a constant number of revolutions of the saw, it is normally found that these factors vary proportionately with the density of the feed. At high densities increased production results at the expense of lint quality, but there is no significant difference in the quality of the lint when low and medium density feeding are employed.

The advantages of air-blast ginning, it will be seen, depend primarily upon the fact that the brush is now discarded, and its imperfections, therefore, eliminated. To infer, however, that it is the shortcomings of the brush system which make more apparent the merits of the air-blast method would be quite erroneous.

An analysis of the technique of saw gins and ginning would scarcely be complete without some reference to the more common defects therein. Already this has been partly dealt with in a discussion of brush and air-blast gins, but mention must now be made of those parts common to both classes of machine. In this respect the saws call for prior consideration, since they are often directly responsible for lint deterioration and irregular shortening of the staple. It is important to note that special conditions are necessary for each distinct staple and grade of lint, and the setting of the saws must be modified accordingly. If this fact alone were rigidly attended to, many of the defects wrongly attributed to the gin would immediately disappear. If ginning is performed with a high density feed and the saw-teeth in a blunt condition, the faults of nepping and cutting will occur, and particularly if a high saw speed is attempted. Although the importance of attention to saw-teeth is becoming more generally realized, in many ginning centres the employment of saw sharpening tools is very rarely practised, and in consequence the lint suffers. The correction of saw disc eccentricity is likewise important, and even though special tools are available their use is very often neglected, with the result that the mote content appreciably increases, a greater proportion of seed passes forward with the ginned lint, and cutting may become more accentuated. Attention to such factors makes for satisfactory and efficient ginning, as can readily be seen from an analysis of the lint. The improvements which have been made in recent years in feeding methods and the installation of cleaners, etc., have greatly helped to reduce the amount of damage sustained by the saw discs on account of

the presence of hard substances in the seed-cotton. Nevertheless, many things are normally done in the ginning process which disturb the parallelism and correct setting of grids and discs, and render periodic and frequent supervision essential.

With modern ginning equipment the quantity of foreign substances, such as sand, leaf, dust, and motes, found in the lint decreases considerably, the amount of waste extracted during ginning varying from 1½ to 3½ per cent., according to the systems of cleaning applied, the type of cotton, etc.

Roller Ginning Technique.

The variable character of the technique involved in saw ginning affords interesting comparison with normal ginning practice on the roller system. It may be stated that the variables are fewer in number in the latter method, although their importance is no less. A comparison of the ginning technique of these two classes of machines has, on occasions, been made, although there is very little published evidence thereof. The most representative type of roller gin is undoubtedly the M'Carthy, used principally in Egypt, India, and certain of the cotton-fields within the Empire. The question of which type of gin is preferable for a particular variety of cotton comes into immediate prominence in any comparison of saw and roller gins.

In regard to out-turn it is readily conceded that the roller gin is inferior to the saw machine, although precisely to what degree it is impossible to say owing to the various elements involved. For example, the production of both gins will vary with the character of the cotton. Usually, however, the out-turn of the saw gin is from three to five times that of the roller machine, taking as representative machines a 50-saw gin with 12-inch diameter saws, and a single acting roller gin, 40 inches wide. For cottons, therefore, where lint quality is not regarded as important, a saw gin may be preferred. In other cases the ginner is confronted with the more intricate question of whether he can afford to sacrifice output for quality. So far as the ginning operation itself is concerned, the more gentle action of the roller gin is a valuable asset, and particularly in the treatment of the longer stapled and finer fibred cottons. To decide which system is the more suitable is often very different from deciding which is the more profitable, although there is a close relationship between the two points. If, for example, by roller ginning a longer lint can be obtained, and at the same time the cotton is more attractive to the buyer, then the decision depends

upon whether the buyer recognizes this difference by paying a correspondingly higher price. If this premium is not forthcoming, the question of quantity versus quality is settled in favour of the former.

Although the nature of the treatment on a roller gin is, normally, less detrimental to the lint, the gin details and processing demand careful consideration, not only by themselves, but also in conjunction with the physical characteristics of the cotton to be ginned. Just as certain cottons respond differently to saw ginning, so also varying characteristics in the lint influence in different ways the manner in which the defibration is performed in a roller gin. It does not necessarily follow, however, that a certain significant character of any particular lint will affect, in like manner, the ginning technique on the two machines; it often happens that a character unfavourable

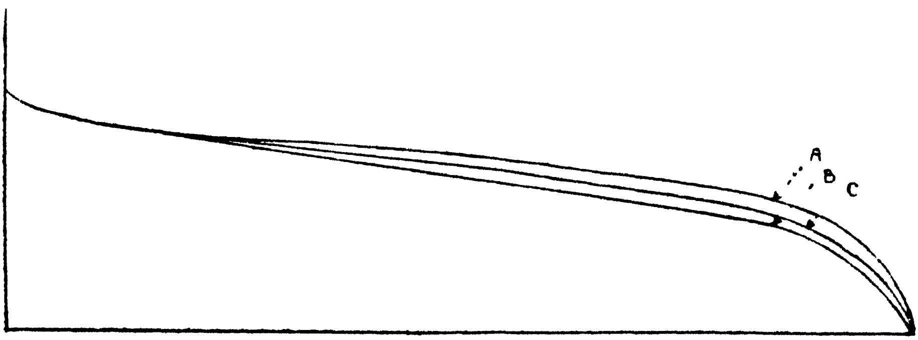


FIG. 4.—"SORTER" TRACES OF HAND PULLED (A), SAW GINNED (B), AND ROLLER GINNED (C) LINT.

to roller ginning is not so to saw ginning, for the actions of the machines are so very different. An example of this may be found in the fact that fuzzy seed-cotton gives a higher out-turn on a saw gin than on a roller gin.

A preliminary consideration of the influence of ginning on lint quality, and a comparison of the suitability of saw and roller gins for any particular cotton, may be made by an analysis of "sorter" diagrams. Although some work on these lines has already been performed, the amount of definite information derived has, generally speaking, served only to emphasize the necessity for more. Such a method of investigation, applied to ginning technique, is particularly useful and indicative of the efficiency of the ginning performance under varying conditions. Three "Sorter" diagrams are given (Fig. 4) to illustrate the length distribution of lint which has been hand-pulled (A), saw ginned (B), and roller ginned (C).

The hair distribution traces are those of an Empire grown cotton, $1\frac{3}{16}$ inches staple, for which it is claimed that both saw and roller gins are applicable. So far as shortening of the lint lengths is concerned, the diagrams indicate the relative merits of the two machines, and definitely give preference to the roller gin, on account of its less injurious action. The shortening of the staple is usually made quite apparent by the orthodox practice of hand stapling, and especially when the lint has suffered much damage from faulty ginning. The diagrams, however, reveal clearly and precisely the effect of ginning on increasing increments in lint length, and enable an accurate idea to be formed as to the correct operation of a gin. Brief reference only is made in this article to the value of " sorter " diagrams (the use and importance of which may be greatly extended) in relation to ginning technique, since a discussion on this subject would prove of too lengthy a nature.

In the course of its development, the ordinary roller gin has passed through many changes of design, and within recent years rather more attention has been paid to it. This gin is made with either one or two rollers, or with a single or double action, the selection of any particular type being made according to the nature and properties of the cotton. Thus, for example, the double roller gin is generally recognized as being most adapted for the ginning of fuzzy seed-cottons and for short staples, in the ginning of which defibration is rendered comparatively difficult on account of the tenacious adherence of the lint to the seed. The latter feature is a primary reason for the employment of this type of gin for short-stapled Indian cottons.

Roller gins for many of the Empire cottons can scarcely be regarded as being as desirable as saw machines, largely on account of their relatively restricted out-turn. In respect of ginning performance, however, very little adverse criticism can be directed at the roller system for such cottons, some of which, it may be noted, are very liable to form neps. The tendency for the roller gin to cause neps is somewhat peculiar, and particularly with certain varieties of cotton. No doubt this susceptibility to nepping originates in the rubbing action generated by the roller, in conjunction with some imperfection causing protracted action. Attempts to gin cottons which firmly adhere to the seed, on a roller machine of unsuitable design and setting, generally accentuate this defect, solely on account of dilatory detachment of the lint. The more important causes of delayed action may be briefly classified as (*a*) too much and irregular wear in the surface of the roller; (*b*) bottom

edge of the fixed knife becoming blunt and worn; and (c) improper condition, or sluggish action, of the beater bar. Detailed discussion of these points is quite unnecessary, as the remedy in every case is obvious. The influence of settings and adjustments on faulty ginning, however, must not be disregarded, for although the possibility of error on this account has been reduced on modern gins, the necessity still exists for a careful consideration of both cotton and machine, modifying the latter according to the requirements of the former. To exemplify this, reference may be made to gin adjustment for varying lengths of staple. The relative dispositions of beater bar and fixed doctor knife, under such conditions, require attention, for longer staples, orthodox practice allowing the beater bar a deeper stroke relative to the knife. The position of the knife in relation to the roller, also, is adjustable according to the type of cotton. Thus, for clean seed-cottons, in conjunction with a comparatively soft leather roller, it is quite common to set the knife slightly above the centre of the roller. Fuzzy seed-cottons, however, with a hard leather roller, generally require a central disposition, or perhaps it will be necessary to set the knife a little below the roller centre to secure satisfactory processing. In this instance the character of the cotton is an important factor in the setting of the parts mentioned, but the minor influence of the nature of the roller must be appreciated.

It is interesting to note how, in recent years, the construction of the M'Carthy gin has assumed a reasonable measure of standardization. In the older forms of gin simplicity of adjustment was not altogether satisfactory, three adjustments being necessary, and demanding fairly frequent attention. These were the height of the roller, the position of the beater shaft, and the height of the fixed knife. The later gins require only one of these adjustments, viz., the height of the fixed knife against which the roller is pressed by weights. By adopting this design a regular pressure is obtained, and provision is made for the automatic adjustment of the height of the roller centre, as the roller diameter varies owing to wear. This type of construction, also, is more beneficial to the roller surface since, being of a flexible nature, it will permit the passing forward of any extraneous matter, which otherwise would become wedged between the roller and knife, causing considerable damage to both. In addition to the simplification of machine adjustment, further advantages in increased production and reduction of labour are now resulting from the application of hoppers for feeding. There is much variation in the speed at which these machines operate,

the principal influence being the grade and characteristics of the lint to be ginned. It is not uncommon to gin at speeds of 900 to 1,000 r.p.m., with a view to increasing production.

Ginnery Organization.

The lay-out of a ginnery operating with saw machines has demanded much study with a view to minimizing labour, cheapening the cost of the process, and securing greater simplicity. The method of coupling together three to five gins to form a battery has met with much favour, and may be said to constitute the most modern and economical system. With this battery lay-out, each gin has an automatic feeding arrangement, instead of the feed lattice, and the hoppers are fed by a pneumatic pipe and conduit running across the top of the battery. The inlet of the pneumatic pipe is usually outside the ginnery, although, if desired, it may be placed in a cotton-seed storehouse (the importance of which has already been emphasized) and furnished with a telescopic section to be raised or lowered on to the seed-cotton.

The suction necessary to draw the cotton through the pipe and deliver it into the gin hoppers is provided by a powerful suction fan at the end of the pipe-line. The hoppers are closed at the top by means of a canvas valve, an automatically operated "make-and-break" in the pipe, between the fan and the battery, causing, when closed, the necessary suction to raise the cotton in the pipe. The opening of the valve mechanism destroys the suction, the canvas valves in the hoppers drop, and the cotton is deposited into the hoppers, which deliver it evenly to the gins. The conveyance of the lint to the condenser is, likewise, performed pneumatically by pipe-line coupled to it, and into which each gin delivers its lint. The simplicity of this arrangement, as compared with the individual condenser method, will be readily realized. The adaptability of the system, and the very easy way in which any ginning unit can be excluded from the battery, are further features, although it is important to observe that more attention must be paid to the feeding system, control of valves, etc.

The pneumatic or battery lay-out is also very favourable to the adoption of automatic systems for removing from the machines seeds, impurities, etc., by means of spiral conveyors, and the majority of saw gins now adopt these devices. In some instances the ginned seeds are automatically conveyed in this way to the delinting machines placed immediately below the gins.

Although the application of pneumatic systems to roller-gin installations is sometimes met with, comparatively little progress, generally speaking, has been made in this direction. The large number of gins often found in a roller ginnery renders difficult the application of existent pneumatic systems, by complicating the seed-cotton distribution. On rare occasions, however, it is possible to find roller gins operating with complete pneumatic means for feeding and condensing, although more frequently pneumatic feeding only is adopted. The system of self-feeding by suction has not proved very popular, and the majority of ginneries have declined to use it on the grounds that a boy or girl can feed more regularly, and so ensure a better flow of cotton through the machine, with a consequently improved out-turn. Where self-feeding systems are applied, it is usual to provide each gin with an automatic feeder, to secure a regular degree of feeding. Although automatic systems have had little success in roller ginneries, and although the machines are not so favourable as saw gins to the adoption of such methods, it is felt that in time pneumatic systems must be applied, even if the mode of application differs from that of the saw-battery system.

For certain classes of seed-cotton, the employment of seed-cotton openers, in conjunction with roller gins, is an advantageous policy, exercising no small influence on lint quality and production and helping to reduce damage to the gins by removing foreign substances. Although the machine has not secured general application, its inclusion is certainly helpful, and in many cases economical, one machine serving for ten to twenty double-acting gins.

One of the most important considerations in ginnery organization is that of avoiding indiscriminate seed mixing. To emphasize the far-reaching and disastrous consequences of this evil would be quite superfluous, although a statement of reliable and simple methods for its avoidance would be most welcome. Unfortunately, practice and experience would appear to indicate that absolute freedom from mixing is practically an impossibility when ginning is conducted on a large scale and under orthodox methods. It is apparently a matter of the degree to which mixing is carried out, the degree, of course, being subordinate to the amount of care exercised.

Received February, 1930.

THE GENTLE ART OF MISQUOTATION

It is a pity that twenty months spent in Egypt should have soured Mr. Barritt's view of life, and left him with an itch to criticize his late colleagues Templeton and Brown, as well as myself. Criticism is a useful mirror to the victim, if properly held up, but special pleadings by means of misquotation and misrepresentation are not useful criticism, and should not appear under the thin disguise of a scientific communication.*

Does Mr. Barritt suppose that because Mr. C. H. Brown does not rush into print at every opportunity and "makes no comment" on flowering curves, that Mr. Brown does not study them? Mr. Barritt can extract a positive coincidence from p. 8 of Mr. Brown's technical *Bulletin No.* 90. Is it not possible that Brown and I can produce the reverse coincidence from the very next page of the same bulletin? I am sorry Brown is on leave at the moment, so I must do it myself, thus:

Mr. Barritt claims that yield follows quality, that strength follows waste, and he takes quality to be simply strength in singles; that is, from data on p. 8. But on p. 9 we get Giza 7 grown in various places in Upper Egypt and spun from three of them:

	Yield in Rotls.	*Waste Per Cent.*	*Lea Break in Lbs.*		
			3·25 Singles.	*3·75 Singles.*	*Twofold.*
Giza	542	23·1	2,376	2,026	3,842
Mansafis ..	818	21·6	2,233	1,864	3,875
Maragha ..	444	24·6	2,368	1,976	3,904

Enormous yield-advantage at Mansafis makes the least waste, the weakest singles, and the intermediate twofold! And what is "quality," so glibly assumed by Mr. Barritt? Is it singles, or twofold, or both, or neither? And confining oneself to "statements of observed fact," it seems to me that "19·7, 21·5, 24·7, and 23·4" is not a series of figures which shows "a progressive increase," they look to my biased eye as if they were slightly unprogressive at the

* "Plant Development Curves and the Branching of Cotton." This Journal, Vol. VII., p. 114.

end. Lastly, though Mr. Barritt could not know it from the publication quoted, the Giza spinning sample did not come from the flowering curve he reproduces, but from the flatter flowering curves of Plot 11.

I apologize to Brown for appearing to defend him in his absence. Turn to my own assertion—mine, according to Mr. Barritt—that "excessive growth due to manuring never gave rise to a reduced yield of cotton." I never said it, it is not a true statement, and anybody can check its impossibility by the *reductio ad absurdum*. I admit this is the lie direct, but what I wrote in the quoted reference was "with regard to the many cases in which it is stated that manuring diminishes the yield through causing too rank growth. The *author* has never yet met with a case under *Egyptian conditions* in which growth was ever the cause of reduced *yield in itself*." That is a cautious scientific statement of personal experience about growth, containing three reservations, not a blind assertion about manures as misquoted by Mr. Barritt.

My book just quoted goes on a few lines further, till the paragraph ends thus (A):

(A.)	(B.)
"A more thorough analysis may ultimately relegate this view *to the limbo whither several venerable fictions have already been dispatched such as the dictum* that," etc., etc.	"The steep flowering curve may therefore perhaps be relegated *to the limbo whither several venerable fictions have already been dispatched, such as the dicta* that," etc., etc.

The parallel column (B) copies Mr. Barritt's own words on p. 117. Or are they mine? And were they worth cribbing anyhow? And is imitation a really sincere form of flattery? I am so glad that, although Mr. Barritt thinks Templeton and Brown and I are stupid fellows about cotton, yet he does admire and copy our literary touch. Of course I think he is wrong, both ways at once.

He misquotes others, who are said to have shown that the flowering curve did not fit the growth curve "at an interval of twenty-three days as claimed by Balls, nor at any other interval." But what Bailey and Trought (p. 39) really said was: "We have been unable to find any regular coincidence in fluctuation after an interval of about forty-two days, and in fact . . . we have suggested 'fits' between the two curves at almost any interval between twenty and forty days." They made a cautious statement, like me, and in view of recent unpublished work at Giza which has displayed an indubitable predetermination period of about twenty-six days, as well as demonstrating their forty-two-day period concurrently, it is evident that their caution was justified, and should be taken by Mr. Barritt as a model.

Any misquotation seems permissible as a liftable stick for the purpose of beating "Workers in Egypt" who have "come to believe that the ideal plant should have a steep and narrow flowering curve so as to ensure an early crop capable of being picked almost in one operation . . . notwithstanding the fact that Williams in 1926 showed conclusively," etc. How these "Workers in Egypt" could have neglected C. B. Williams's ideas is inconceivable until I look up the reference and find C. B. himself writing that "one of our previous hopes is probably doomed to failure, although we are still left with the possibility of using a quick maturing cotton, which would give the largest possible part of the crop in the first picking." The view which Barritt says was shown to be quite inadmissible by Williams, is what Williams said himself! Or again, "Balls accounted for this abscission by the formation of a cork layer," reference p. 68 of "Raw Cotton," was an entirely casual remark about shedding when speaking of some abnormal old bolls figured by Bowman. My original account of abscission, in some detail, is on pp. 58-9 of the "Cotton Plant in Egypt," and never once says "cork."

Mr. Barritt thinks he has discovered and taught something about the form of flowering curves per plant, by comparing incommensurables. He has compared the closest-sown crop in Egypt at Fashn, on the richest land, with our crop on rather poor soil at Giza in the widest spacing used, on a plot which was insufficiently watered, so showing a premature senescence drop. He even misquotes the curves themselves, which in his figure are not "the mean curve for each locality," but are the curves given by the strain Giza 2 above in three cases, this strain having the steepest curve of all the varieties, while the Fashn curve is vague.

I detest controversy, and am breaking the habit of years in writing this note, but Mr. Barritt has sent his pitcher to the well of inaccuracy once too often. I do not mind if Mr. Barritt's readers should disbelieve my own views, but I should be very sorry if they thought that only a real expert (to wit, Mr. Barritt) could so boldly criticize reputed experts—namely, Templeton, Brown, and myself.

The scientific communication here criticized is five pages long. I have only dealt with three of them; Dr. Templeton is dealing with the other two.

W. Lawrence Balls.

After seeing Dr. Balls's criticism of the first three pages of Mr. Barritt's "scientific" contribution, it is evident that there remains very little for me to add, but what applies to the first three

pages as regards misrepresentation of facts, misquotation, etc., applies with perhaps even greater force to the last two.

I am sorry, however, that Mr. Barritt is not a believer in the steep flowering curve, for a plant such as was described by me (Ministry of Agriculture, Egypt, *Bull.* 87) and which gives a higher yield than Maarad, is already being cultivated in Egypt. But of course, if he *will* compare the yield and flowering curves from Giza with those from Fashn without considering such inessential things as spacing, shedding, climate, manure, soil, and pink bollworm in the two districts, he need not be surprised if he falls into error. Even in spite of Mr. Barritt I am afraid I am still a believer in the steep flowering curve for Egypt.

As a contrast to my stupid ideas about the steep flowering curve, let me quote Mr. Barritt's opinion as to how to improve the yield: "An increase in the number of effective flowering branches can be more successfully obtained by increasing the number of plants per unit area of soil, *whereby the root system is increased in like proportion to the branches*" (the italics are mine). Apart from the fact that Mr. Barritt proposes to increase the root system as the available space decreases, it is a pity that close planting would actually give him his despised steep flowering curve! He seems later to have realized this, however, for in the last paragraph, p. 118, he proceeds to show how bad this is for yield or quality or both. This afterthought was apparently put in for the sake of clearness as to his real meaning.

Would it be unkind to suggest that he should follow his own suggestion that "for scientific study it is necessary to substitute statements of observed fact for mere expression of opinion"?

However, even Mr. Barritt is entitled to his own opinions, I suppose, but when he descends to misrepresentation of the work of others that is another matter.

He states that where I claimed 100 per cent. increase for ratoons in a particular locality the controls were so obviously abnormal that no safe conclusions can be drawn. What Mr. Barritt did not realize is that his so-called abnormal control is the normal first year crop obtained in the district. He *will* be pleased to learn that permission is now given for the cultivation of ratoons in this district!

Referring to my experiments on topping cotton plants, Barritt states that I hint (in *Bulletin* 87) at special methods of increasing the yield. I myself can find no such hint unless he construes it from my statement that "an account of the effects of topping plants at different times in the season will be published shortly"!

Again, Mr. Barritt states that Bailey carried out similar topping experiments to mine in the Sudan and recorded decreased yields at all stages of growth. This is only partly true. In Bailey's first experiments he records "somewhat favourable results" after topping, but in the following year these results were reversed. Incidentally my experiments have not so far been described, so that Mr. Barritt must be trusting to his memory, and here again he is wrong. There is practically no similarity in the method of procedure between Bailey's experiments and mine.

The lower strength recorded by Summers for ratoon cotton is accepted by Mr. Barritt as conclusive, and no reference is made to the numerous tests carried out for me at the Shirley Institute and Bollington and recorded in *Bulletin* 75 of the Ministry of Agriculture, Egypt, and that in spite of the fact that Summers had to compare one sample of ratoon from one year's growth with a sample of annual from another. Further comment is unnecessary, but one would have thought it impossible to crowd so many misquotations and misrepresentations into so few pages as are occupied by Mr. Barritt's article.

J. TEMPLETON.

COTTON STATISTICS

INDIA—SMALLER CROPS

BY

JOHN A. TODD, M.A., B.L.

In the last issue we gave our usual table of the World's Crops with particulars of the American and Egyptian crops. This time we give similar details of the Indian crop, and another table containing details of all the other crops (except Empire). This table was formerly called "Smaller" Crops, but that is hardly appropriate now as it includes Russia and China. As a matter of fact, since last issue we have been revising the whole of our figures of these "Other Crops" since 1914, and the new table gives the results. The figures, therefore, do not tally exactly with those given in our table of the World's Crops in last issue. This issue also contains a table of the Empire crops compiled by the Empire Cotton Growing Corporation.

With regard to India, the final result of the 1929-30 crop is rather a serious disappointment. It is the smallest crop since 1926, and the lowest average yield (except 1926) since 1920. It will be seen from the details of the crop by Varieties and by Provinces, given in Tables III. and IV., that the shortage is largely in Bombay, where the yield is no better than it was last year, and that was very low owing to the frost in Gujerat. Central Provinces are also well down this year.

As regards the distribution between long and short staple varieties, the latter if anything suffered most this year, especially Western and Northern varieties and the Hyderabad group. It must be remembered, however, that the attribution of this latter group to the long staple section is very doubtful. Only part of these crops should be regarded as long staple, but unfortunately we have no means of adjusting the proportion correctly each year. It is satisfactory to note, on the other hand, that American cotton in the Punjab and Sind has done much better this year.

Last year attention was drawn to the fact that the totals given in the "Provinces" and "Varieties" tables did not always tally

with each other. The explanation was that the Indian Government have a habit of revising their statistics in the following year, and sometimes even the second year afterwards, but on several occasions it has happened that while revised figures by Provinces were published two years afterwards, this was not accompanied by a revision of the "Varieties" table, hence the discrepancy. As it happens, however, the question does not arise this year, as the 1927-28 figures remain the same in both cases.

Table II. on p. 220 gives the details of the Commercial crop for 1928-29; the figures for 1929-30 are, of course, not yet available. It will be noticed that 1928-29 returned to the normal discrepancy from the Government's estimate. The fact that the discrepancy is so large in this case is partly a reaction from the previous season, when for the first time for many years the commercial crop was less than the Government's estimate.

With regard to the "Other Crops" table, the chief items of interest are the steady recovery of Russia and the rapid growth of the Argentine crop in recent years. The details for 1929-30 are, of course, very hypothetical at this stage of the season.

TABLE I.—INDIAN CROP, AREA, YIELD, AND PRICE, 1914–1929.

Seasons.	*Area (Acres).* 000's.	*Crop (Bales of 400 Lbs.).* 000's.	*Yield per Acre. (Lbs.)*	*Net Exports and Consumption.* 000's.	*Season's Average Prices.*	
					No. 1 Fine Oomra.	*Per Cent. on American.*
1914–15 ..	24,595	5,209	85	4,889	4·46	85
1915–16 ..	17,746	3,738	84	5,109	6·09	81
1916–17 ..	21,745	4,489	83	4,985	10·32	84
1917–18 ..	25,188	4,000	64	4,499	18·78	87
1918–19 ..	20,997	3,972	76	3,991	18·13	92
1919–20 ..	23,352	5,796	99	5,343	19·23	76
1920–21 ..	21,340	3,600	67	4,941	9·20	77
1921–22 ..	18,451	4,485	97	5,972	9·60	85
1922–23 ..	21,804	5,073	93	6,270	11·14	75
1923–24 ..	23,631	5,161	87	5,946	13·35	74
1924–25 ..	26,801	6,088	91	6,923	11·95	87
1925–26 ..	28,403	6,215	88	6,508	8·97	83
1926–27 ..	24,822	5,024	81	5,624	7·18	88
1927–28 ..	24,761	5,963	96	5,661	9·21	83
1928–29 ..	27,053	5,811	86	6,674	8 03	76
1929-30 ..	25,692	5,260	82	—	—	—

TABLE II.—INDIAN "COMMERCIAL" CROP.

(RUNNING BALES 000's.)

Seasons.	*Net Exports.*	*Mill Consumption.*	*Domestic Consumption.*	*Total.*
1914-15	2,118	1,771	1,000	4,889
1915-16	2,486	1,873	750	5,109
1916-17	2,081	2,154	750	4,985
1917-18	1,705	2,044	750	4,499
1918-19	1,238	2,003	750	3,991
1919-20	2,680	1,913	750	5,343
1920-21	2,113	2,078	750	4,941
1921-22	3,063	2,159	750	5,972
1922-23	3,411	2,109	750	6,270
1923-24	3,350	1,846	750	5,946*
1924-25	3,998	2,175	750	6,923
1925-26	3,775	1,983	750	6,508
1926-27	2,830	2,044	750	5,624
1927-28	3,140	1,771	750	5,661
1928-29	3,933	1,991	750	6,674

* Up till 1923-24 the imports were deducted, because some of the mills in the Native States included foreign cotton in their consumption.

TABLE III.—INDIAN COTTON CROP: AREA, CROP, AND YIELD PER ACRE *BY VARIETIES*.

Varieties.	1926–27.			1927–28.			1928–29.			1929–30.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*
I. *Mainly under $\frac{7}{8}$ Inch Staple:*												
Oomra (Khandeish, Central India, Berar, and Central Provinces) . .	8,224	1,573	76	8,096	1,891	94	8,420	2,031	96	8,550	1,728	81
Dhollera	2,485	569	92	3,072	858	112	3,094	402	52	2,784	522	75
Bengal Sind (United Provinces, Rajputana, Sind, Punjab, etc.) . .	3,363	822	98	2,782	782	112	3,586	1,020	114	3,529	1,051	119
Comilla, Burma, etc.	588	114	78	470	104	89	460	92	80	460	104	90
Coconada	205	30	59	214	39	73	236	46	78	225	37	66
Total under $\frac{7}{8}$ inch staple . .	14,865	3,108	83	14,634	3,674	100	15,796	3,591	91	15,548	3,442	89
Per cent. of total crop	60·0	61·9	—	59·1	61·6	—	58·4	61·8	—	60·5	65·4	—
II. *Mainly $\frac{7}{8}$ Inch Staple and Above:*												
Punjab (American)	1,134	229	81	750	219	117	974	189	78	825	253	123
Sind (American)	25	5	80	15	3	80	29	6	83	27	8	119
Broach	1,211	222	73	1,274	244	77	1,270	209	66	1.304	281	86
Coompta Dharwar	1,513	201	53	1,726	327	76	1,945	303	62	1,685	291	69
Western and Northern	1,795	173	39	1,534	221	58	1,835	349	76	1,472	161	44
Tinnevelly	525	135	103	568	148	104	610	163	107	596	159	107
Salem	181	34	75	181	34	75	224	43	77	242	42	69
Cambodia	309	116	150	287	123	171	384	146	152	403	151	150
Barsi and Nagar } Hyderabad Gaorani }	3,264	802	98	3,792	970	102	3,986	812	81	3,590	472	53
Total $\frac{7}{8}$ inch staple and above . .	9,957	1,917	77	10,127	2,289	90	11,257	2,220	79	10,144	1,818	72
Per cent. of total crop	40·0	38·1	—	40·9	38·4	—	41·6	38·2	—	39·5	34·6	—
Grand total	24,822	5,025	81	24,761	5,963	96	27,053	5,811	86	25,692	5,260	82

000's omitted throughout in area and crop figures.

TABLE IV.—INDIAN COTTON CROP: AREA, CROP AND YIELD PER ACRE *BY PROVINCES.*

	1925–26.			1926–27.			1927–28.			1928–29.			1929–30.		
	Area (Acres).	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.).*	*Area (Acres).*	*Crop (Bales).*	*Yield per Acre (Lbs.)*
Madras	2,921	569	78	2,231	388	70	2,123	447	84	2,495	528	85	2,476	509	82
Mysore	83	25	120	97	25	103	81	25	123	76	23	121	69	22	128
Hyderabad	3,781	1,060	177	3,267	808	99	3,631	951	105	4.019	895	89	3,536	447	51
Bombay*	8,123	1,567	77	6,918	1,290	75	7,765	1,802	93	8,048	1,477	73	7,153	1,310	73
Baroda	866	189	87	761	124	65	806	124	62	793	68	34	771	127	66
Central Provinces and Berar	5,385	980	73	4,864	977	80	4,796	1,235	103	5,078	1,334	105	5,167	1,142	88
Central India ..	1,369	270	79	1,297	223	69	1,263	234	74	1,287	252	78	1,388	249	72
Gwalior	651	116	71	649	107	66	585	115	79	645	107	66	633	89	56
Bengal	78	26	133	77	25	130	78	20	103	79	18	91	78	21	108
Bihar and Orissa ..	82	15	73	79	14	71	77	14	73	78	14	72	69	13	75
United Provinces ..	1,004	277	110	809	258	128	643	199	124	715	255	143	932	342	147
Rajputana	411	93	91	404	78	77	422	97	92	476	123	103	506	104	82
Ajmer Merwara ..	54	17	126	43	15	140	42	14	133	44	21	191	34	11	129
Punjab	3,052	908	119	2,803	599	85	2,068	602	117	2,841	619	87	2,496	788	126
North-West Frontier..	32	7	87	30	5	67	10	2	73	17	4	94	17	4	94
Assam	47	13	111	46	15	130	45	15	133	44	17	155	44	15	136
Burma	464	83	72	447	73	65	326	67	82	318	56	70	323	67	83
Total	28,403	6,215	88	24,822	5,024	81	24,761	5,963	96	27,053	5,811	86	25,692	5,260	82

* Including Native States, also Sind and Delhi. 000's omitted throughout in area and crop figures.

TABLE V.—WORLD'S CROPS OTHER THAN AMERICAN, EGYPTIAN, AND EMPIRE.

(In 000's of 500-Lb. Bales Approx.)

	1914-5.	1915-6.	1916-7.	1917-8.	1918-9.	1919-20.	1920-1.	1921-2.	1922-3.	1923-4.	1924-5.	1925-6.	1926-7.	1927-8.	1928-9.	1929-30.
America.																*
Mexico	125	114	120	105	205	200	194	145	191	160	255	199	352	179	273	235
Brazil	456	312	310	374	374	463	430	491	538	561	649	585	480	487	530	550
Peru	118	105	119	120	132	159	166	181	187	199	198	186	248	235	210	210
Argentine ..	3	4	3	12	15	15	28	18	29	62	75	136	64	103	180	230
Others	11	11	12	12	11	28	39	45	26	67	84	70	75	58	77	75
Asia.																
China	2,333	1,882	1,534	2,046	2,903	2,497	1,829	1,489	2.249	1,931	2,114	2,044	1,657	1,835	1,804	1,850
Japan and Korea	37	45	37	60	71	92	103	89	106	113	122	122	141	131	150	138
East Indies, etc.	23	23	37	16	25	20	31	27	26	21	20	19	15	17	16	15
Russia	1,070	1,303	1,142	618	288	210	73	81	54	215	443	749	745	946	1,148	1,345
Persia	139	133	95	82	85	150	102	95	63	79	58	82	83	75	121	120
Asia Minor and Europe ..	135	109	115	102	94	111	104	43	37	76	107	158	132	213	130	152
Africa.																
Non-British ..	4	3	7	8	8	11	13	16	26	39	65	74	76	88	77	75
West Indies.																
Non-British ...	11	7	7	9	8	17	11	22	17	17	19	25	25	22	24	25
Total ..	4,465	4,051	3,538	3,564	4,219	3,973	3,123	2,742	3,549	3,540	4,209	4,449	4,093	4,389	4,740	5,020

* Our estimates underlined.

EMPIRE COTTON CROPS FOR ELEVEN YEARS 1919-29, EXCLUDING INDIA.

(*In bales of* 400 *lbs.*)

The seasons are given as covering two years (*e.g.*, 1926–1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Iraq, Cyprus, Malta), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown in the *latter* of the two years at the head of the column.*

Country.	1918–19.	1919–20.	1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	
(1) Anglo-Egyptian Sudan ..	15,997	23,160	30,519	24,074	28,306	47,652	44,912	121,131	148,118	126,115	161,536	(1)
(2) Gold Coast ..	52	—	61	49	15	93	1,132	1,218	285	264	296	(2)
(3) Nigeria	17,500	16,200	30,000	15,096	16,811	25,694	39,137	47,909	27,464	20,930	32,126	(3)
(4) Uganda	36,530	47,694	81,365	48,290	88,046	128,604	196,038	180,859	131,728	138,486	204,057	(4)
(5) Kenya	100	100	500	417	1,200	1,653	2,250	2,046	1,232	1,241	1,984	(5)
(6) Nyasaland ..	2,591	2,026	4,615	5,422	4,036	6,873	7,718	4,976	2,792	4,470	6,095	(6)
(7) N. Rhodesia ..	56	35	100	80	102	500	379	506	32	17	—	(7)
(8) S. Rhodesia ..	—	—	—	—	—	1,650	4,907	6,803	639	90	280	(8)
(9) Tanganyika ..	—	—	7,327	7,175	11,434	18,793	21,724	24,280	15,966	32,965	29,454	(9)
(10) Union of South Africa and Swaziland ..	1,911	2,737	2,923	2,740	6,523	8,730	16,936	20,381	10,242	11,013	9,774	(10)
(11) West Indies ..	6,361	5,787	4,763	4,314	5,295	4,309	4,186	5,941	6,076	4,088	5,312	(11)
(12) Queensland ..	31	38	792	3,140	9,344	11,850	14,318	7,179	5,880	10,266	6,298	(12)
(13) Cyprus	3,325	2,687	2,547	1,505	2,233	3,397	3,320	4,614	2,110	2,146	3,610	(13)
(14) Malta	343	266	582	193	118	573	782	507	342	541	379	(14)
(15) Iraq	—	60	60	300	1,100	2,400	2,540	3,500	1,800	5,200	4,700	(15)
(16) Fiji	—	—	—	—	85	157	123	824	356	114	271	(16)
(17) Ceylon	—	—	—	—	49	324	121	261	186	202	380	(17)
	84,797	100,790	166,154	112,795	174,697	263,252	360,523	432,935	355,248	358,148	466,550	
	•	*Percentage Increase* 18·8.	*Percentage Increase* 64·8.	*Percentage Decrease* 32·1.	*Percentage Increase* 54·8.	*Percentage Increase* 50·6.	*Percentage Increase* 36·9.	*Percentage Increase* 20·0.	*Percentage Decrease* 17·9.	*Percentage Increase* 0·8.	*Percentage Increase* 30·2.	

* The adoption of this practice for the purpose of giving consistency to the records has necessitated the transference of the figures for certain countries to a previous column. The totals in this table will consequently be found to differ slightly from those previously published.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

The following reports have recently been received:

AHMEDABAD: Rpt. of the Millowners' Association, 1928-29.
INDIAN CENTRAL COTTON COMMITTEE: Ann. Rpt. for year to August 31, 1929.
MYSORE: Agr. Calendar, 1930.
PUNJAB: Rpt. on the Operations of the Dpt. of Agr., 1929, Pt. I.
PUSA: Scientific Reports of the Agricultural Research Inst., 1928-29.

289. INDIAN CENTRAL COTTON COMMITTEE. (*Ann. Rpt. for the year ended August* 31, 1929.) The following features stand out prominently in the Committee's work and policy during the year under review, all of which are carefully commented on under their respective headings:—(1) The increasing interest taken by Trade members in the Committee's Agricultural Research Schemes; (2) the utilization of the Committee's Laboratory for testing trade samples; (3) the formation of a permanent Sub-Committee on Malpractices to deal with all references to malpractices and abuses which are adversely affecting Indian cotton, and to examine the efficacy of all measures already suggested to stop them; (4) the change in policy whereby the Committee will assist, by the provision of staff or funds, in the wider distribution of the seed of improved varieties of cotton to the growers; (5) the decision of the Committee to help local authorities to disseminate as widely as possible the results of the research schemes financed from the Committee's grants. It was the original intention of the Committee to go no further than carry a research scheme to its conclusion and leave Local Governments to do the propaganda work necessary to get the results taken up by the grower. The change in policy should have a marked effect on the rapidity with which improvements are introduced.

290. COTTON IN THE PUNJAB. (*Rpt. on the Operations of the Dpt. of Agr., Punjab,* 1929, Pt. I.) The Cotton Research Botanist, Mr. Trevor Trought, has been engaged in separating and testing new varieties of some 114 pure-line families of American cotton and 77 of Desi. The results have not reached a definite stage, but one of the new cottons, which was grown on 8 acres, is sufficiently promising. It is said to mature early, has a better staple than 4 F., is as high in yield as 289 F., and, moreover, shows considerable resistance to those factors which induce failure in other Punjab-American cottons. Another type, which is still under observation, gives promise of being even superior to this. Careful observations are being made as to the effect of irrigation, sun, light, and soil temperature.

The chief cotton pests encountered during the year were grasshoppers, crickets, pink bollworm, spotted bollworm, cotton-stem borer, cotton semi-loppers, red cotton bugs, and cotton white fly. The last-named insect has received the greatest attention, and a survey of the cotton-growing tracts in the Punjab was undertaken with a view to discovering the status and distribution of the pest. Its life history and seasonal history have now been fully worked out, and investigations are proceeding in order to throw light on the relation of the insect to the partial failure of the cotton crop in the Punjab which occurred again last year.

291. CROP ROTATION EXPERIMENTS AT THE LYALLPUR FARM, PUNJAB. By D. P. Johnston. (*Agr. J. of India,* xxv., 1, 1930, p. 3.) *Summary of Conclusions.* Where wheat has followed cotton the yields obtained have been, on the

average, 30 per cent. higher than where wheat has followed wheat. Yields obtained from the more important crops indicate an improvement in the soil fertility of the block as a whole since the present experiment was laid down. There has been a gradual improvement in the fertility of the soil under all rotations since the present experiment was laid down. The rotations of higher intensity have improved soil fertility more than those of lower intensity. Any one of the rotations now practised is more suitable for the maintenance of soil fertility than the previous rotation: wheat—wheat—toria—cotton. Where one crop follows another without the land being allowed a rest the yields of such crop have consistently declined. The net returns obtained from the land under the experiment have increased from the first to the third cycle and also with the intensity of cultivation. [*Cf.* Abstract **164**, p. 139 this Review.]

292. Report on a Visit to the Punjab and Sind. By Captain Lord Stanley M.P. (No. 111. British Cotton Growing Assen., 1930.) An account of a visit paid to the British Cotton Growing Association's farm at Khanewal and to the Sukkur barrage. The cultivation of the 4 F. variety of Punjab-American cotton has been discontinued at Khanewal; it has been replaced by the 289 F. variety, which has proved superior in yield and in immunity to disease. In connection with the "white fly" pest, the entomologist deputed by the Indian Central Cotton Committee is doing valuable work at Khanewal, and the pest can in part be controlled by spraying with a compound of rosin and soda. Additional yields of from 100 to 200 lb. per acre may result from the treatment, and control by this method on a semi-commercial scale will be undertaken next season.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

293. The following reports have recently been received:

Imperial Coll. of Sci. and Tech., 22nd Ann. Rpt. of the Governing Body, 1929.
Imperial Institute, Ann. Rpt., 1929.
Kenya: Agr. Census, 1929, 10th Ann. Rpt.
Queensland: Ann. Rpt. of Dpt. of Agr. and Stock, 1928-29.
Tanganyika: Ann. Rpt. of Dpt. of Agr., 1928-29, Pt. I.
Uganda: Col. Ann. Rpt., 1928.
West Indies: *Antigua:* Rpt. on the Agr. Dpt., 1928-29.
Barbados: Rpt. of Dpt. of Sci. and Agr., 1928-29.
Grenada: Rpt. on the Agr. Dpt. for the period 1926-28.
Montserrat: Rpt. of Agr. Dpt. for the years 1927-29.

294. Empire Cotton: its Increasing Use. By John A. Todd. (*Times Trade and Eng. Supplement,* May 24, 1930, p. 26.) The central thesis of this important paper is the decline in consumption of American cotton (*i.e.*, grown in the U.S.) that is now showing itself. The chief reason appears to be the deterioration in *quality* of the crop, due largely to the use of early maturing varieties to combat the boll weevil. Unfortunately the Empire fields are not yet in a position to make up this decline (for the world consumption as a whole is not falling off), though they are now coming into their own. The last paragraph of the article reads: "The consoling thing about the Empire supplies is that in every case they are among the best of their class; and that while the United States has to lament the all-round deterioration of her crop in both quantity and quality, the Empire fields have consistently worked to produce the very best cotton they can grow. Before the war Empire cottons were grudgingly accepted in Lancashire by spinners who thought it rather a matter of patriotism that they should take the trouble to use these outside growths. Now all that is changed; Empire cottons have come into their own, and are everywhere accepted on their merits."
[*Cf.* Abstracts, Vol. V., **239**, **240**, **377**, **526**; Vol. VI., **194**, **466**, **583**; Vol. VII., **36**, **37**, **189**, **190**, **191**, **192**.]

295. National Cotton Week. (*M/c. Guar.*, May 10, 1930.) One of the main objects of this campaign was to stimulate manufacturers psychologically, to put more heart into their efforts to win back Lancashire's trade, and not merely to provide a temporary material increase in sales. "The Organization Committee," said Mr. Raymond Street, the secretary, to a *Manchester Guardian* representative, "is thoroughly satisfied that the week has been well worth while. It has vastly improved the general tone of the whole market."

296. Climate, Crops and Soils in British Tropical Colonies. By F. J. Martin. (Conf. of Empire Meteorologists, 1929, *Papers and Discussions*, p. 42. Pubd. H.M. Stat. Off., price 1s. net.) The object of this paper is to give some account of the climate, crops and soils of British Tropical Colonics, with a view to tracing any existing relationships, and further, to see if such data are of use to the practical agriculturist in the colonies, or if they can assist the research worker in problems connected with agriculture.

297. East Africa. *Report of the East African Guaranteed Loan Committee appointed by the Secretary of State for the Colonies*, 1926-29. The original allot ment of this loan is dealt with in Abstract **408**, vol. iii., p. 389, of this Review, and the present report describes the progress made, the various changes that experience has shown to be necessary, and the new schemes which have been considered by the Committee since July, 1926.

298. Road Transport in East Africa. By C. Kemp. (*Econ. Conditions in E. Afr.*, 1929.) The Uganda Government proposes to spend about £150,000 from surplus balances for the purpose of building a system of feeder roads in the south-western district of the Territory, with the object of facilitating the evacuation of produce from the Kivu district of the Belgian Congo via Uganda and the Kenya and Uganda railway system. At the same time some 100 miles of the Kagera River are being opened up to the navigation of Lake Victoria craft.

The Association of East African Chambers of Commerce is pressing upon the Governments concerned the necessity of improving road communications between Kenya and the northern area of Tanganyika Territory. A new road alignment between Kenya and Moshi-Arusha is under construction, and consideration has also been given to the improvement of coast communications between Mombasa, Tanga, and Dar-es-Salaam.

It has recently been possible for motor transport to proceed from Blantyre (Nyasaland) to Salisbury (Southern Rhodesia) via Tete in Portuguese East Africa by a new road that is in process of construction. When the various sections of this road are completed by about the end of 1930 it can be considered as virtually an all-weather communication.

Work continues upon both the Great East and Great North roads in Northern Rhodesia. The former is 380 miles and the latter 1,040 miles in length.

299. Nigeria. *Cotton Cultivation.* (*Half-Yearly Rpt. of Dpt. of Agr. to March* 31, 1930.) *Northern Provinces:* The purchases of American cotton for export for the 1929-30 season are equivalent to about 35,000 bales of 400 lb., which is not far short of the record of 1925-26. The season was exceptionally favourable to the crop as the rains were good, and there was no threatening of food shortage. The expansion of cotton-growing in Sokoto has continued without a check since 1926-27, and there is no reason, if prices are favourable, why steady progress should not be maintained. It is possible that a ginnery in the Zamfara valley will be found necessary in the near future. Efforts are being made to encourage cotton-growing in the North Bedde area, which is served by the new Kano-Hadeija railway. The general quality of the American crop this season has been below average, especially in Sokoto. In this Province the indigenous cotton, known locally as "Labai," so closely resembles Allen cotton that the detection of

admixture in the seed-cotton is rendered extremely difficult for those engaged in grading at the markets. The Botanists' selection "D" has this year yielded as well as the existing commercial strain, while its quality and high ginning percentage have been maintained. This type will be multiplied still further, and it is hoped that some 700 tons of seed will be available for general distribution in 1931. The Botanists are endeavouring to produce still further improved strains, and they now have three or four varieties which appear to be at least as good as "D," and these are being tested on a field scale. Some of the newly-introduced exotic cottons are promising, and further tests on the best of them will be conducted this year.

Daudawa Seed Farm: This farm, maintained by the Empire Cotton Growing Corporation, is yearly becoming of increasing importance for the maintenance of a supply of improved cotton seed for the Northern Provinces. This year 392 acres are under cotton, in addition to other farm crops grown in rotation. The cotton grown has consisted exclusively of the Botanists' strain "D."

In the *Middle Belt*, at Ilorin, Bida, and in the Benue Province, work has been continued to determine the most suitable varieties for profitable production at these centres.

Ishan Cotton: In 1928 some 16 tons of Improved Ishan seed were disposed of at ½d. per lb., while a further 5 tons were issued free of charge. The total export of lint derived from the crop grown from this seed was 921 bales, or 44 bales per ton of seed. The policy of making a nominal charge for the improved seed was fully justified in checking wastage, as well as in educating the farmer to appreciate the value of the new type. There was a keen demand for the seed in 1929, and some 103 tons were sold at ½d. per lb. in addition to 7 tons issued free to Meko farmers for multiplication purposes. Ishan cotton has completely replaced Native in many areas. The 1929-30 season has been generally favourable both as regards yield and quality, and the percentage of first-grade of both Ishan and Native cotton has been unprecedented.

Southern Provinces: The season was more favourable climatically than was anticipated, and the following excellent yields were obtained at Moor Plantation:

	Lbs. of Seed Cotton per Acre.
Ishan cotton after Mucuna green manure	1,140
Ishan cotton interplanted through groundnuts	1,000
Ishan cotton interplanted through yams	883

These yields were remarkably good, obtained as they were without the aid of artificial manure or fertilizer of any kind.

300. SOUTH AFRICA. *Cotton Prospects.* (*Cape Argus*, April 9, 1930.) Mr. J. C. Homewood, Government Cotton Grader at Durban, states that the 1929-30 cotton crop will show an increase of about 75 per cent. over that of the 1928-29 season. This is attributed to the planting of better seed, mainly the variety known as U.4, coupled with improved rainfall and climatic conditions generally.

301. SOUTHERN RHODESIA. *Cotton Prospects* 1929-30 *Season.* (*Crops and Markets*, S. Afr., viii., 7, 1930, p. 140.) The new variety, U. 4, which is now chiefly planted, has not hitherto been grown on a commercial scale in the Colony. The crop at present promises well, and if the yield from 8,000 acres be estimated at 300 lb. of seed cotton per acre (a conservative figure), the total yield would amount to 2,400,000 lb. of seed cotton, yielding about 800,000 lb. of lint.

302. TANGANYIKA. *Cotton Cultivation* (*Ann. Rpt. of Dpt. of Agr.*, 1928-29, recently received.) The output of cotton for the year 1928 was 32,954 bales, which constituted a record for the Territory. The provision of Cotton Market Supervisors, through a cess collected on all purchases of native seed cotton, for the markets in the Morogoro-Kilosa area, has proved very successful and effec-

tive, and it is proposed to extend the scheme to other areas with leased cotton markets—namely, Mwanza Province and Lindi area. The valuable assistance rendered by the British Cotton Growing Association in the provision of a pioneer ginnery in Biharamulo, Bukoba, has enabled useful preliminary progress to be made for endowing a backward tribe, isolated until recently, with a money crop, and it is hoped that this assistance will be extended to Ufipa-Rukwa and Songea.

The following experiments carried out at the different stations are described: Varietal trials, time of sowing and distance of sowing experiments at Morogoro; varietal trials, time of sowing, spacing, ratooning, and economic production of cotton experiments at Mpanganya; time of sowing and distance of sowing experiments at Abadakuli.

The chief pests encountered during the year were pink bollworm, locust (*Schistocerca gregaria*, F.), and red stainers, but comparatively little damage was caused to the cotton crop. In addition to the fungi and diseases mentioned in the previous reports (*cf.* Abstract **470**, Vol. VI., p. 292), four others were observed: Violet Root disease (*Rhizoctonia crocorum* [Pers.], D.C.), a leaf-spot caused by an incompletely identified species of *Ascochyta*, a *Diplodina* sp. found once on unhealthy plants, and *Gibberella moniliforme*, Winch. (conidial stage), found once in open bolls. Of all the vegetable parasites found in cotton, only seven are considered of importance: *Bacterium malvacearum*, E.F.S., *Nematospora gossypii*, A. and N., *Mycosphærella gossypina* (Atk.), Earle, *Ramularia areola*, Atk., *Ascochyta* sp., *Kuehneola gossypii*, Arthur, and *R. crocorum* (Pers.), D.C.

303. *Cotton Cultivation.* (*Int. Rev. of Agr.*, Rome, xxi., **4**, 1930, p. 159.) Advices received are to the effect that new cotton planting began under excellent conditions throughout the territory thanks to abundant rains, which permitted considerable intensification of agricultural work.

304. *Work of the Mpanganya Agricultural Station*, 1929. By A. J. Wakefield. (*Bull. of Imp. Inst.*, xxviii., **1**, 1930, p. 73.) Time of sowing, spacing, and ratooning experiments are described, and an account is given of the work done in connection with the interplanting of cotton in other crops.

305. AUSTRALASIA: QUEENSLAND. *Cotton Cultivation.* (*Ann. Rpt. of Dpt. of Agr. and Stock*, 1928-29, recently received.) From the report of the Cotton Specialist we learn that the climatic conditions were very unsatisfactory during the growing period, which will result in a considerably lower yield than that of last season. Mr. Wells continues: "Fortunately, however, fine weather was experienced throughout most of the harvesting period which allowed of rather higher average grades being obtained than those of the preceding season. Owing, also, to the fact that it has been possible to dispose of most of the lower grades in Australia this season, it appears that prices comparable with those of the 1927-28 crop may be obtained. These features, in conjunction with the Cotton Board's arrangements, whereby higher first advances could be paid upon the arrival of the seed cotton at the ginnery, have saved what might otherwise have been a very disastrous season for the cotton-growing industry."

The incidence of pests throughout the different areas was of somewhat severe economic importance; the most serious damage was caused by corn-ear worm, pink bollworm, large cotton stainer, and cutworms.

306. *Cotton Industry.* (*Int. Cott. Bull.*, viii., **31**, 1930, p. 435.) Mr. Walker, Queensland Minister of Agriculture,—in announcing recently that an agreement had been reached for the Cotton Board, on behalf of the growers belonging to the British and Australian Cotton Association, to take over ginneries and oil mills, and thus place the enterprise on a co-operative basis,—said the Government had given careful consideration to the future of the cotton industry, and after exhaustive examination had ascertained that the yield per acre compared more than favourably with that of the United States, that the average crop was superior,

and the average value 85 points above American middling. Production costs compared very favourably.

The Association owned six ginneries throughout Queensland and an oil mill near Brisbane. The purchase price has been agreed upon at £137,500. An additional £18,000 will be spent on modernizing the equipment.

Advices received from Sydney state that the Federal Prime Minister has announced his intention to provide for the continuance of the cotton bounties to cotton planters for five years from August next, when the present bounty expires. The bounty varies in diminishing amounts from 1½d. to ½d. a pound, disappearing in 1936.

307. Fiji. *Résumé of Work at the Cotton Experimental Station.* By R. R. Anson. (*Agr. J.*, Fiji, iii., 1, 1930, p. 11.) An interesting description of the work that has been carried out at the Station with the object of evolving a strain of cotton suitable for Fijian conditions, and which would also give promise of being commercially successful. K. 3.2—a variety bred from Kidney Hybrid cotton brought originally from New Guinea by Mr. Evans—has been chosen for distribution to growers during the current season. There is enough seed of this variety available to plant up roughly 600 acres.

Mr. Anson is of opinion that a better plan would be to produce two strains of cotton for Fiji: (1) A coarse stapled variety measuring about 1⅛ in. which could be used for mixing with wool, and (2) a fine-stapled cotton measuring about 1½ in. which could be sold against Egyptians. At the present time both of these types are selling well on the English market, and if one type should drop in price there would be a supply of seed available of the other, and it could be put on the market in a short space of time.

Fijians are becoming every year more interested in cotton, and to further stimulate their interest it is suggested that agricultural implements should be supplied to villages, on the understanding that they be paid for from the proceeds of the crop at the end of the season.

An important fact which should not be lost sight of is that the grower should not depend upon cotton alone for his livelihood; it should be grown in conjunction with other crops, and rotated with a legume.

308. WEST INDIES: Antigua. *Cotton Industry.* (*Rpt. on the Agr. Dpt.*, 1928-29.) In 1928 the area planted to cotton was 248 acres, but owing to the attacks of Pink bollworm only 17,700 lb. of lint were exported.

The hurricane of September, 1928, destroyed most of the cotton planted for the 1929 crop, so that resowing was necessary. The acreage finally planted was 245 acres, and since there was a remarkable freedom from Pink bollworm attack a larger crop was expected to be reaped.

During the year the Antigua Cotton Growers' Association bore the cost of the erection of a breeding cage for conducting experiments in ascertaining the time of the year the pink bollworm moth emerges, but the work was abruptly terminated by the hurricane in September. It is intended to continue the experiments in the next season.

309. Cotton in Barbados. (*Rpt. on the Dpt. of Sci. and Agr.*, 1928-29.) Experiments with cotton have been continued in view of the possibility of effecting control of Pink bollworm. These experiments aim at producing a heavy yielding, early maturing strain, from which, in the local sense, there would be "one picking" obtained in the shortest possible time, and before the crop has suffered much injury from Pink bollworm infestation. Varieties other than Sea Island cotton are also being experimented with.

310. Cotton Production in Carriacou. (*Rpt. on the Agr. Dpt., Grenada,* 1926 *to* 1928, received 1930.) The small island of Carriacou is mainly owned and occupied by peasant proprietors, who raise food crops and domestic animals

for their own use, sell any surplus, and also grow Marie Galante cotton as a cash crop. Their requirements are few, and accordingly there is but little incentive to produce large crops for sale, or to work for others. The value of the cotton crop remains reasonably steady, about £15,000 (say 3,000 cwt. of lint).

311. MONTSERRAT. *Cotton Cultivation*, 1929. (*West India Comm. Circ.*, xlv., **821**, 1930, p. 110.) The very high rainfall in Montserrat during 1929 materially helped in the general restoration of the vegetation and agriculture. At the same time it was the cause of widespread bacterial boll disease in the cotton crop, but owing to the almost complete absence of Pink bollworm the late flowers developed and largely made up for the shortage previously anticipated. The cotton crop amounted to about 700,000 lb. of lint.

312. *Cotton in Montserrat.* (*Bull. of Imp. Inst.*, xxviii., **1**, 1930, p. 72.) Efforts were made during 1929 to perpetuate the pure line strain of Heaton Sea Island. Special investigational work was initiated with the object of purifying the strain for high boll loculi values. A start was also made to breed out nep from the cotton, and to this end it is of interest to state that an isolation was discovered which gave no trace of lethal seeds. This isolation forms the starting-point of this special investigation.

313. ST. VINCENT. *Cotton Prospects.* (*West India Comm. Circ.*, xlv., **821**, 1930, p. 115.) The Sea Island cotton crop this season shows a decided improvement over that of any previous year. If weather conditions continue favourable there is likely to be very little stained cotton reaped. The crop, however, is not expected to exceed 400 bales, though next year it should be considerably more.

314. *Cotton Prospects in St. Vincent.* From a report, recently received, on the cotton crop for the quarter ended March 31 last, we learn that the return per acre from the area under cotton will be an improvement on that for the past few seasons. There was a noticeable decrease in the number of bolls attacked by soft rot, and consequently there will be a decrease in the amount of stained cotton produced. Very little damage was caused by cotton worms during the quarter. Stainers made their appearance in some localities, but were not responsible for much injury.

COTTON IN EGYPT.

315. COTTON ACREAGE LIMITATION. (*Int. Cot. Bull.*, viii., **31**, 1930, p. 483.) It is stated that the proposal to reimpose the law restricting the area of land which may be sown with cotton in any one year to one-third of the total cultivated land in Egypt, is certain to arouse lively controversy, especially in view of last year's experience when the restriction was obviously not rigidly enforced.

The matter is then discussed, and the paper ends with the following sentence: "From an economic standpoint it is undoubtedly desirable that the policy of concentration upon one crop should be changed. It is doubtful whether Egypt has hitherto suffered by devoting too much attention to cotton, to the neglect of other products, because, even at present price levels, cotton still remains the most profitable crop that can be grown here. Should values fall much lower, however, cotton would be definitely a non-paying crop to grow, and, since its culture is the principal aim of nearly every agriculturist, the whole industry would be faced with a crisis from which emergence would be difficult because the potentialities of alternative products have until now been neglected."

316. EGYPTIAN COTTON: WATERING. By L. Geisser. (*Leipziger Monats. Text. Ind.*, **45**, 1930, 101-102. Abstr. from *Summ. of Curr. Lit.*, x., **7**, 1930, p. 152.) The origin of the custom, methods of watering cotton, reasons for doing so, and means for preventing watering with fraudulent intent are discussed. The information given is that obtained by a special committee of the Alexandria General Produce Association in their investigation of the watering of cotton.

317. Cotton Growing Problems: Effects of Inadequate Drainage. By A. M. Psalti. (*Egyptian Govt. Gazette*, February 21, 1930.) It is stated that irrigation tends to be pushed on without due consideration of the equally important subject of drainage, so that injury may be done by an excessive rise in the water table. An appeal is made to Government to take the necessary action and spend money more lavishly on the maintenance of old drains and the opening up of new ones.

COTTON IN THE UNITED STATES.

318. American Textile Notes. By W. Whittam. "*Acreage Reduction.* (*Text. Rec.*, xlvii., **565**, 1930, p. 78.) From every side acreage reduction is being urged. Officials of Co-operative Associations, banks, State officials and the Farm Board are working to that end. Mr. Carl Williams, cotton member of the Federal Farm Board, warns cotton growers that unless drastic reduction takes place they 'face disaster.' He declares that over 40,000,000 acres will mean no profit at all. He likewise warns against the lowering of quality while other countries are steadily bettering theirs." [*Cf.* Abstracts **294** above, and **319** below.]

319. What Price Cotton? By W. L. Clayton. (*Int. Cot. Bull.*, viii., **31**, 1930, p. 475.) A statement of the author's views on the inability of the American cotton farmer to produce cotton at a world economic price. The pamphlet is well worth the study of cotton men. [*Cf.* **318** above.]

320. Growing Staple Cotton. (*Text. Rec.*, xlviii., **566**, 1930, p. 72.) Following the example set years ago by the English Fine Spinners' Association, the Berkshire Fine Spinners' Association (Mass.) have gone in for growing staple cotton to fill their own requirements. Three farms are being operated in the Mississippi Delta, on which 2,500 negroes and 1,000 mules are at work. The stated object is primarily not to produce cotton cheaply so much as to ensure a supply of the uniform quality needed.

321. The American Cotton Co-operative Association. By A. Northington. (*Int. Cot. Bull.*, viii., **31**, 1930, p. 447.) The American Cotton Co-operative Association is the national organization of the Cotton Co-operatives, and is recognized and approved in form by the Federal Farm Board. Its authorized capital is $30,000,000, and it is empowered under its articles of incorporation and by-laws, among other things, to act as a central selling agency for its stockholder co-operative marketing associations. All of the cotton co-operatives of the country, with the exception of the Staple Cotton Co-operative Association at Greenwood, Mississippi, make up its ownership, and will be the beneficiaries of whatever success may result.

An account is then given of the various activities of the Association.

322. The Status of Co-operative Marketing in Arkansas. By B. M. Gile. (*Bull. No.* 245, Agr. Exp. Sta., Arkansas, 1929.) The Arkansas Cotton Growers' Co-operative Association was incorporated in 1922 to market the growers' cotton by the co-operative method. Other large associations were also formed, being organized as non-stock and non-profit associations. A grower became a member by signing a contract to deliver his cotton to an association usually for a period of five years.

A full description is given of the organization and of the difficulties encountered—*e.g.*, developing credit relations with the banks, arranging for storage and a satisfactory pooling system.

A decline in business since 1926 has prevented the lowering of overhead charges. 56 per cent. of the members expressed themselves as satisfied, or largely satisfied, with the results obtained, and 39 per cent. as definitely not satisfied.

The chief reason for this seemed to be that there were not enough members in the Association to enable it to control local prices. In the peak year, 1926, only about 10 per cent. of the growers were members. The volume of business declined after that year, and in 1927-28 the Association only handled 1 per cent. of the total cotton of Arkansas.

In the final paragraph it is considered that, with the experience now gained, the Co-operative Associations, with their undoubted advantages, should begin to go ahead.

323. Economic Conditions of Farmers in Oklahoma as related to Membership in the Oklahoma Cotton Growers' Association. By W. W. Fetrow. (*Oklahoma Sta. Bull.*, 186, 1929. Abstr. from *Exp. Sta. Rec.*, 62, 5, 1930, p. 485.) Tables, maps, and graphs are given and discussed, showing the findings as to tenancy, stability, economic progress, and sources of farm income of the members and non-members of the Association.

324. Condition of Farmers in a White-Farmer Area of the Cotton Piedmont, 1924-26. By H. A. Turner and L. D. Howell. (*U.S. Dpt. Agr. Circ.* 78, 1929. Abstr. from *Exp. Sta. Rec.*, 62, 3, 1930, p. 280.) Gives the results of a study of the tenure status, financial progress, and standards of living of a group of white farmers in Gwinnett, a typical cotton county of Piedmont, Georgia, farmed mainly by whites.

325. Human Factors in Cotton Culture. By R. B. Vance. (*Chapel Hill: Univ. N.C. Press*, 1929. Abstr. from *Exp. Sta. Rec.*, 62, 3, 1930, p. 280.) This is a study in the social geography of the American South, in which the material is considered under the following chapter headings: Cotton and regionalism; the cotton belt—its regions and its human ecology; the evolution of the cotton system; the risks of cotton production—the weather and the weevil; the risks of the cotton market; around the year with cotton growers; the cotton system at the turn of the quarter-century; how the cotton farmer lives; human elements in cotton culture; the cotton culture complex. A selected bibliography is included.

326. Commercial Fertilizers in 1928-29 and their Uses. By G. S. Fraps and S. E. Asbury. (*Bull. No.* 403, *Tex. Agr. Exp. Sta.*, 1929.) Contains statistics regarding fertilizers sold in Texas, information regarding the fertilizer law, and analyses of samples of the fertilizers sold by different manufacturers. The extent to which the various manufacturers are coming up to their guarantees is also shown. A discussion is included of the use of fertilizers, and suggestions for their use on various crops and in various sections of the State. Tables are also given showing the approximate quantity of fertilizer applied per acre, and percentage of the crops fertilized for some of the counties which use fertilizers.

[*Cf.* Abstract 317, Vol. VI., p. 262.]

327. Cotton Experiments in Arkansas. (41*st Ann. Rpt. Agr. Exp. Sta.*, 1928-29.) Experiments with fertilizers are still being continued in co-operation with farmers, and sixty-four have been completed. They showed a considerable profit with the use of nitrate of soda, especially with the first 100 lb. per acre. Superphosphate was also very profitable. The profits diminished with increasing rate of application. Home mixing proved superior to factory mixing.

Other experiments described include breeding, spacing, factors affecting the abundance of the boll weevil, and a genetical, physiological and pathological study of the cotton plant with special reference to wilt disease and the breeding of wilt-resistant varieties. This work has progressed to the point that it can be said without hesitation that there are now excellent strains of cotton well suited to practically every condition in Arkansas, which, in addition to being good yielders and vigorous growers, are for all practical purposes wilt resistant.

Several strains of Express, Lightning Express, Dixie Triumph, several strains of Rowden—including Rowden 40—some of the D. and P.L. strains, and the Super Seven strains should be specially mentioned in this connection.

328. Cotton in California. (*Southern California Crops*, vi., **3**, 1930, p. 7.) It is stated that the 1930 cotton acreage will be materially reduced in all sections of the south-west owing to unremunerative prices.

329. A Fertilizer Study on the Brown Soil of the Red Prairies. By H. F. Murphy. (*Oklahoma Sta. Bull.* 188, 1929. Abstr. from *Exp. Sta. Rec.*, 62, **3**, 1930, p. 211.) General fertilizer tests showed that cotton is the only crop of which the yield on the soil under consideration can be increased enough by fertilizer treatment to pay a profit. Superphosphate either alone, or in combination with manure or with manure and limestone, could be applied with some profit, but limestone alone was applied at a loss.

330. Varieties of Cotton for the Blackland Region of Central Texas. By D. T. Killough *et al.* (*Bull. No.* 399, Texas Agr. Exp. Sta., 1929.) Varieties of cotton having high percentages of lint, and producing a staple of $\frac{7}{8}$ to 1 inch in length, made the highest yields of lint per acre, and were generally the more profitable ones tested at Temple in the Blackland region of Central Texas during the sixteen years 1912-27. Statistics show that cotton of the above lengths is in greatest demand by the American mills.

Kasch made the highest yield of lint during this period, Qualla second, and New Boykin third, although the difference in yield is probably not significant. These three varieties were followed in yield by Harper, Anton, Sunshine, Lankart, Lone Star, Mebane, Truitt, and Cliott Superior in the order named. Snowflake produced the longest lint, which averaged $1\frac{9}{32}$ inches. It was followed by Durango, Acala, and Lone Star, which had lint of $1\frac{1}{8}$, $1\frac{1}{16}$, and 1 inch respectively. Lone Star was the only one of these four varieties that was rated as a high yielder.

Lankart produced the largest bolls, 68 weighing 1 lb. of seed cotton. The bolls of Belton, Kasch, Mebane, Cliett Superior, Qualla, and Harper were also relatively large, requiring 73 to 78 to the pound. The bolls of these varieties were storm-resistant, yet easy to pick.

The higher-yielding varieties were all relatively early-maturing, and produced over two-thirds of their total crop at the first picking.

A study was made of the money value of the higher-yielding varieties tested since 1922, based on yield of lint and length of lint. The average prices paid on the New Orleans market during December of each year were used in determining the total acre value of these varieties. New Boykin and Kasch had an acre value of over $56, Acala $52.19, Lone Star $51.60, Mebane $50.92, Lankart $50.74, and Sunshine $50.48.

COTTON IN FOREIGN COUNTRIES.

331. Argentine. *Cotton Cultivation.* (*Int. Cot. Bull.*, viii., **31**, 1930, p. 435.) It is believed that about 300,000 acres will be planted to cotton this year, as against 260,000 acres last year. The cotton for the 1928-29 season is said to have been of good quality as growers are reported to have secured good prices.

332. Chinese Textile Industry. (*Text. Rec.*, xlvii., **565**, 1930, p. 84.) The Chinese cotton-spinning mills had a very satisfactory year in 1929. The anti-Japanese boycott prevented the Japanese cotton mills in China from getting much of the business in cotton yarns during the first half of 1929. During the year China had a total of 120 cotton mills with 3,664,120 spinning spindles, 185,896

twisting spindles, and 29,582 looms. The annual production of cotton yarn is placed at about 880,000,000 lb. and 586,000,000 yards of cloth. Of this quantity China-owned mills accounted for 549,115,000 lb. of yarn and 240,362,000 yards of cloth.

333. CHINESE TEXTILE MARKET. By W. Buchler. (*Text. World.*, 77, 1930, 1760-62. Abstr. from *Summ. of Curr. Lit.*, x., 8, 1930, p. 209.) The bulk of yarns imported are grey or unbleached, and all woollen and worsted yarns and cord. The present principal demand in cotton yarn is for counts up to and including 10's, above 12's up to 23's. Methods of marketing in China are outlined, and it is pointed out that wars and other disturbances in the country do not affect trade to any very serious extent, and although fluctuations in Chinese currency are apt to occur, the market is only disturbed temporarily.

334. ASSOCIATION COTONNIÈRE COLONIALE. We have received a copy of *Bull. No.* 90, 1930, containing the following articles: " Extension et organisation de la culture cotonnière en Tunisie "; " La Culture du Coton dans l'État de Syrie," " Remarques sur la culture Syrienne de 1929." In the last article it is stated that the area under cotton has increased from 4,385 hectares in 1928 to 17,349 hectares in 1929. Most of the area is under " Baladi " cotton.

335. ITALY. *Cotton Cultivation.* (*Int. Cot. Bull.*, viii., 31, 1930, p. 436.) The area planted to cotton in 1929-30 was 7,800 acres, the production of ginned cotton amounting to 3,100 bales.

336. LO STABILIMENTO GOVERNATIVO PER LA SGRANATURA E L'IMBALLAGGIO DEL COTONE DI VITTORIO D'AFRICA. By A. Ferrara. (*L'Agr. Coloniale*, xxiv., 1, 1930, Firenze, Italy.) An account of the establishment of a Government ginnery in Italian Somaliland, and of the opening ceremony by the Duke of Abruzzi.

337. THE TEXTILE INDUSTRIES OF INDIA AND JAPAN. By A. S. Pearse. (*Indian Text. Jour.*, xl., 474, 1930, p. 265.) Mr. Pearse, in talking about Japan, said that the working hours were 476 per month, as against 188 in England and 240 in India. The spindles are almost all ring spindles, so that the total outturn is greater than in France or Germany. The group spirit in Japan leads to greater enthusiasm in work than the trade union spirit of the West. Great combines are the order of the day. The general conditions of work, mill architecture, attraction of labour to the mills, welfare work, etc., are also dealt with.

338. JAPANESE MILLS: EFFECT OF ABOLITION OF MIDNIGHT WORKING. (*Cotton*, M/c. 35, No. 1690, 1929, p. 26. Abstr. from *J. of Text. Inst.*, xxi., 1, 1930, A59.) The abolition of midnight working in Japanese cotton-spinning mills from July 1, 1929, will result in an actual reduction in working hours of a little over 8 per cent. To meet these conditions the spinning-mills have increased the number of their spindles. Efforts have also been made to promote a higher standard of efficiency, —through the improvement of equipment, adoption of better installations, and the rationalization of management—and thus to offset the decrease of productive capacity due to the abolition of midnight working.

339. PERU. *Cotton Cultivation.* (*Int. Cot. Bull.*, viii., 31, 1930, p. 436.) Advices to hand state that there is a sufficient supply of water for the cotton crop, and a good yield is anticipated.

340. RUSSIA. We have received a copy of the *Annals of the State Institute of Experimental Agronomy* (Leningrad, 1929). The following articles (in Russian) are included in the volume: " A universal Method for Determination of the Exchange Absorption Capacity in Soils," by K. K. Gedroitz; " Contribution to the Study of Crop Rotations," by A. G. Doyarenko; " Experimental Sowing of Cotton in Taman and Kertsh Peninsula in 1929," by I. M. Kouprianov.

341. THE COTTON TRUST OF CENTRAL ASIA. By A. L. Strong. (*Text. Rec.*, xlvii., 562 and 563, 1930.) "One of the largest cotton trusts in the world has sprung into being in the past eight years in Central Asia. It has the monopoly of everything connected with cotton in the Soviet Union. The cotton Committee has a capitalization of 85 million roubles (£9,000,000) representing all its many properties, but without counting land values, since 'land is reckoned as nothing,' or as air and water, in Soviet Union capitalization. Such is the organization built in 1920-21 to meet a situation of utter ruin in the cotton-growing industry of Turkestan.

"The importance of cotton in Central Asia may be seen from the following figures. In Uzbekistan, the central Republic, including Tashkent, Samarkand, and Bokhara, cotton forms 46·7 per cent. of the marketable agricultural produce, and the working over of cotton products forms 47·3 per cent. of all industry. Uzbekistan is, therefore, a cotton republic, and must import a large part of its breadstuffs.

"When Professor Zaitzev took charge of the experiment station near Tashkent in 1919, there was a total population of twenty souls including workers and servants. Today, with the scientists, clerks, workers, and their families, the station is a little community of 600 people, maintaining its own school, club, many radio receivers, cinema, central dining-hall, in addition to scores of newly-built quarters for the staff. Professor Zaitzev developed a new variety of cotton which will grow further north than any known variety; the staple is short and the yield less than other varieties, but it is still industrially valuable for the irrigated steppes of Kasakstan.

"The peasant is being paid for raw cotton an average of 4·60 roubles per pood, or 3.25d. per lb. (Russian pood=36 English lb.). In pre-war days he got 3.60d. to 3.70d., but that he is at least fairly satisfied with these prices is shown by the fact that the land planted to cotton grows steadily, at the rate of nearly 20 per cent. for each of the past two years. Central Asia is again reviving, and this is due in no small measure to the protected revival of its cotton-growing industry."

SOILS AND MANURES.

342. SOIL EROSION IN SOUTH AFRICA. By J. L. Serfontein. (*Farming in S. Afr.*, v., **49**, 1930, p. 13.) Deals briefly with the value of the soil, the manner in which erosion takes place, and its chief causes. The article is to be followed by two others—one on the results of erosion, and the other on the means of combating erosion.

343. COTTON PLANT: MANURING WITH VETCHES. By M. J. Funches. (*Biol. Abs.*, 3, 1929; from *J. Amer. Soc. Agr.*, 20, 1928. Abstr. from *Summ. of Curr. Lit.*, x., **7**, 1930, p. 152.) Experiments showed that the early turning under of vetch as a manure for cotton more than doubled the yield of cotton, and equalled an application of 300 lb. of sodium nitrate.

CULTIVATION, ETC.

344. SEED DISINFECTANTS: PENETRATION. By A. Niethammer. (*Mikrochem.*, 1929, 1, 315-7. Abstr. from *Summ. of Curr. Lit.*, x., **3**, 1930, p. 50.) Microchemical reactions for the determination of the penetration of copper sulphate, mercury derivatives of chlorophenol and toluene-sulphonamide, mercuric sulphate and chloride, nickel sulphate and nitrate, and potassium cyanide and sulphate into seeds are outlined. The results of tests on wheat grains show that copper sulphate and the organic mercury compounds at ordinary concentrations do not reach the innermost parts of the seed. The inorganic mercury compounds pass

into the endosperm, embryo, and aleurone when the action is prolonged. Nickel sulphate and nitrate readily diffuse into the interior of the grains. In the case of potassium salts the speed is dependent on the nature of the anion.

345. RECENT EXPERIMENTS IN DRYING SEED COTTON. By C. A. Bennett. (*Agr. Eng.*, 10, 1929, pp. 309-13. Abstr. from *Exp. Sta. Rec.*, 62, **3**, 1930, p. 274.) The results indicated that the time of drying or period of exposure might be anywhere from forty seconds to three minutes. Other tests showed that hot-blast temperatures of from 160° to 175° F. would not endanger the germinating qualities of the seed if the exposure did not exceed fifteen minutes. The volume of heated air required varied from 40 to 100 cu. ft. per pound of damp seed cotton. Upon these fundamental features of drying were based the design and erection of a full-sized drier at a cotton gin, of which a description is given. The total cost of drying a load of seed cotton to make an average bale of cotton lint was about 92 cents. The improvement in the value of the cotton due to drying varied from 0·5 cents per pound to as high as 3 cents per pound.

346. REDUCING COTTON PRODUCTION COSTS BY THE UTILILIZATION OF IMPROVED MACHINERY. By F. R. Jones. (*Agr. Eng.*, 10, **6**, 1929, pp. 183-8. Abstr. from *Exp. Sta. Rec.*, 61, **9**, 1929, p. 885.) The progress data of an investigation at the Texas Experiment Station of the use of improved machinery in cotton production are presented and discussed.

The results indicated that bedding is the heaviest operation, and cultivation the lightest in cotton production, especially where two-row equipment is used. With one tractor handling 100 acres and a yield of one-half bale per acre, the costs of production of the crop per acre and per pound of lint are approximately $25 and 10 cents respectively. With one tractor handling 100 acres and a yield of one bale per acre, the costs of production of the crop per acre and per pound of lint are approximately $35 and 7·01 cents respectively.

The data also show the importance and advantage of a high yield over a low or average yield. In other words, the cost of producing a high yielding crop is very little more than the cost of producing a crop of average yield.

347. MECHANICAL COTTON PICKING. (*Int. Cot. Bull.*, viii., **31**, 1930, p. 470). The General Cotton Picker Company of Fort Worth announce the production of a horse-drawn and a power cotton-picker.

As the machine passes over the cotton row a system of endless chain feeders takes the cotton stalks into the machine, holding them in an upright position as they approach the vertical gangs of revolving picker fingers through which the plants must pass in a slightly compressed condition, the picker fingers operating in and out of the stalks, at the same time having a high rotary motion snatching the cotton from the open bolls. As the fingers or spindles return they shed the cotton. It then drops in a vacuum pan, is elevated by the fan and discharged into the receptacle located on the rear of the machine, thus handling it the same as at the gins, the air current drying any light moisture on the cotton. The makers claim that cotton picked by this cotton-picker under ordinary conditions is cleaner than hand-picked, and frequently its value increased a cent per pound.

348. SAW GIN SAFEGUARDING MECHANISM. By Platt Bros. and Co., Ltd., and T. H. Bradley, Oldham. (Abstr. from *Summ. of Curr. Lit.*, x., **7**, 1930, p. 152.) Double safeguarding mechanism is provided comprising a fixed or adjustable front guard adjacent to the cross-shaft, which carries or operates means permitting the locking or unlocking of the roll-box cover according as the box is down or up.

349. COTTON GIN MOVABLE HOPPER. By Platt Bros. and Co., Ltd., and T. H. Bradley, Oldham. (Abstr. from *Summ. of Curr. Lit.*, x., **7**, 1930, p. 152.) The hopper consists of interconnected side supports comprising upper and lower

portions, the latter masked by the walls of the main frame, the hopper being slidable on anti-friction bowls engaging the edge of the frame from the working position to a position giving access to the knives.

DISEASES, PESTS, ETC.

350. ON NATURAL CONTROL. By W. R. Thompson. (*Parasitology*, xxi., **3**, 1929, pp. 269-281. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **2**, 1930, p. 80.) The author defines natural control as the check exerted on the multiplication of organisms by natural, as opposed to artificial, environmental factors. He considers that the idea that the distribution of an organism is chiefly determined by one or two limiting factors is incorrect. The reduction of reproductive rate preventing an increase or determining a decrease in numbers is due in the vast majority of cases to complex combinations of factors, of which different members predominate in different times and places. It is considered that an organism spreads where it encounters optimum conditions, and thus gives rise to an outbreak. The author believes that the control of insect pests is principally effected by physico-chemical factors, rather than by entomophagous insects. The reason for this is that parasitic control is effected by their specific organisms whose distribution in time and space is limited by their specific requirements, of which the presence of the host is one. Only a few of such organisms are capable of acting upon any given host. The physical factors of control, on the contrary, are simply intensities of omnipresent physical and chemical influences above or below the limits between which a given species can subsist. The range over which they will be found acting is obviously far more extensive than that of the biotic factors. Furthermore, the number of physical factors of control is, for practical purposes, unlimited, since any departure in either the positive or negative direction of any physical factor, from the intensity that a given species can tolerate, will eliminate it. In the main, it appears that such tropical regions as are favourable to life in general will be those in which the biological factors will be of the greatest importance as compared with physical ones, and that in regions unfavourable to life in general they will be relatively unimportant. The part played by biological and physical factors respectively, in the control of any organism in a region, can, however, be determined only by careful investigation, since these general rules are not always applicable. The most promising method for attacking the problem of the natural control of a given species is to determine the ecological optimum by a careful laboratory study of its physiology and habits.

351. ON THE PART PLAYED BY PARASITES IN THE CONTROL OF INSECTS LIVING IN PROTECTED SITUATIONS. By W. R. Thompson. (*Bull. Ent. Res.*, xx., **4**, 1929, pp. 457-462. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **4**, 1930, p. 200.) Many injurious insects live in such a way that a considerable proportion of their population is practically inaccessible to parasites and predators, even during the stages when they are attractive to their enemies. Insects of this type are not infrequently transported in their animal or vegetable food materials into other territories, escaping attention during the process of inspection, and develop in their new homes into devastating pests. In order to be inaccessible to an enemy, the host need not be in what are commonly called protected situations, such as tunnels in the substance of plants or beneath the surface of the soil. The mere fact that it can live in zones in which the parasite or predator cannot survive, or to which it is not attracted, or may be present at times when its enemies are not in a stage when they can attack it, constitutes an equally efficacious protection.

In this paper the part played by parasites in control is studied, and it is concluded that the fact that a proportion of the host population is inaccessible may have an extremely serious effect on the progress of its parasites, even though

the parasite reproduces at a rate that enables it to reach the numerical level of its accessible host population in a short time. The fact that a relatively small proportion of the host population is inaccessible may in certain cases completely prevent a parasite from establishing control. Although a high percentage of hosts is destroyed in every generation, the host population may maintain itself at a level corresponding to economic damage, or even continue to increase. The total proportion of inaccessible hosts must be very low if control is to occur.

352. THE RELATION OF WEATHER TO PLANT DISEASES. By C. E. Foister. (Conf. of Emp. Meteorologists, 1929. *Papers and Discussions*, p. 168.) The relation of weather to plant diseases is briefly outlined, and methods suggested by which the meteorologist can be of assistance to the plant pathologist. Plant diseases caused by parasitic agencies alone are considered.

353. WEATHER AND CLIMATE IN THEIR RELATION TO INSECTS. By B. P. Uvarov. (Conf. of Emp. Meteorologists, 1929. *Papers and Discussions*, p. 130.) The influence on insects of the following meteorological factors is considered: Temperature, Humidity and Precipitation, Wind, Atmospheric Pressure, Atmospheric Electricity, Light, Climate and Weather, Geographical and Ecological Distribution, Cycles and Periodicity.

354. NEW METHODS OF APPLYING HYDROCYANIC ACID IN THE CONTROL OF PESTS. By A. Petrov. (In Russian.) (*Izv. prikl. Ent.*, iv., **1**, pp. 288-290, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **3**, 1930, p. 132.) This is a short review of the use of Zyklon products and of calcium cyanide for fumigating with hydrocyanic acid gas.

355. INDIA. *Cotton Pests.* (*Sci. Rpts. of the Agr. Res. Inst., Pusa,* 1928-29, p. 68.) From the report of the Imperial Entomologist we learn that a study was made during the year of the life-history of an Aleyrodid (*Bemisia gossypiperda*, n. sp.), which was reported to have done considerable damage to cotton in the Punjab during 1928. Larvæ of Pink bollworm were found in some numbers feeding on seeds inside pods of *Hibiscus abelmoschus* at Pusa in January. The Braconid parasitic on the adult weevils of *Myllocerus* 11-*pustulatus* var. *maculosus* attacking cotton plants, previously referred to as *Loxocephalus* sp., has been determined to be a new species of *Dinocampus*, and a technique for rearing it in captivity has been evolved.

[*Cf.* Abstract **253**, Vol. VI., p. 199.]

356. REPORT OF THE GOVERNMENT ENTOMOLOGIST, 1928. By H. H. King. (*Bull. No.* 29, Wellcome Trop. Res. Labs., Sudan Govt., 1929, recently received.) The migratory locust, *Schistocerca gregaria*, reappeared, though in smaller numbers than in the previous year. A dried poison bait—consisting of wheaten bran moistened with a solution of arsenite of soda and treacle in water, and sun-dried—employed as a control, met with complete success, except in parts of Kordofan and Darfur Provinces, where conditions are being studied with a view to preparing a further plan of action.

The damage caused by Pink bollworm in the Gezira was heavier than in the previous season, and a more comprehensive and thorough clean-up was therefore carried out during the summer. Elsewhere than in the Gezira the situation as regards Pink bollworm was normal, except in the southern districts of Kordofan Province, where the pest appeared to be on the increase at the close of the year.

Work carried out during the previous season indicated that there was a heavy mortality amongst the pupæ of Cotton Thrips (*Heliothis indicus*) infesting cotton grown in the Gezira under irrigation. Further investigation of the subject during the year under review showed that the principal cause of this mortality was the mechanical action of the water of irrigation in sealing the pupæ in the

soil. It would appear that control could be effected by timing the waterings early in the season to correspond with the periods when the pupæ are in the soil. The relation of the lubia (*Dolichos lablab*) crop to thrips infestation of cotton also received attention. The fact that under certain conditions thrips breeds freely on lubia, coupled with the tendency evinced by newly matured adults to disperse, renders this crop a possible danger to cotton. It was found that where the lubia produced a luxuriant and dense growth, and received sufficient and regular waterings, its thrips population remained at the minimum.

A considerable amount of work was carried out on hymenopterous parasites of crop pests, particularly those which attack the bollworms of cotton. An interesting fact brought out was that *Microbracon kirkpatricki*, a parasite of Pink bollworm discovered in Kenya and later found to occur in the Sudan, attacks also a lepidopterous larva which feeds in the seed heads of *Abutilon* spp., a common weed. With the object of ascertaining whether indigenous parasites might be rendered of greater use in the control of pests than they are at present, some 9,000 specimens were released in the cotton crop on the Gendettu pumping scheme during the last ten weeks of the year, but the results of the experiment had not been obtained at the time of writing the report.

357. COTTON PESTS IN MISSISSIPPI. (*Miss. Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, 62, **2**, 1930, p. 152.) Work with the Cotton Aphid was conducted by A. L. Hamner. In generation studies, data are given on the first born, last born, and increase of infestation. In control work, both the 5 and 7·5 per cent. nicotine sulphate dusts gave good results, 0·2 lb. of available free nicotine per acre being found to be the most economical rate of application. *Lamium amplexicaule*, one of the two winter hosts—the other being *Rumex crispus*—was found to survive and carry the aphids over.

358. ON THREE NEW CHALCIDOID PARASITES OF PLATYEDRA. By C. Ferrière. (*Bull. Ent. Res.*, xx., **3**, 1929, pp. 255-259. Abstr. from *Rev. App. Ent.*, Ser. A, 1930, p. 55.) *Brachymeria fijiensis*, sp. n., was bred from *Platyedra gossypiella*, Saund., in Fiji. *Eurytoma braconidis*, sp. n., appears to attack Braconid parasites of Lepidoptera, having been recorded from *Microbracon hancocki*, Wlkn., in Uganda, and as a hyperparasite of *Diparopsis castanea*, Hmps., in the Anglo-Egyptian Sudan; it has also been obtained in Tanganyika Territory. *Elasmus johnstoni*, sp. n., was bred from *P. gossypiella* in the Punjab, and from *P. gossypiella*, *Earias insulana*, Boisd., and larvæ in bolls of *Abutilon* sp., in the Anglo-Egyptian Sudan.

359. SARCOPHAGIDEN-STUDIEN. I. BEITRAGE ZUR KENNTNISS DER GATTUNG BLÆSOXIPHA LW. By B. Rohdendorf. (*Zool. Anz.*, lxxvii., pp. 23-28, 1928. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **3**, 1930, p. 98.) *Blæsoxipha filipjevi*, sp. n., a parasite of the larvæ and adults of *Locusta migratoria*, L., is described from the northern Caucasus.

360. THE BIOLOGY OF THYSANOPTERA, WITH REFERENCE TO THE COTTON PLANT. V. THE RELATION BETWEEN THE DEGREE OF INFESTATION AND THE TYPE OF SOIL. By E. I. MacGill. (*Ann. of App. Biology*, xvii., **1**, 1930, p. 150.) In several previous papers on Thysanoptera it has been shown that the condition or type of soil may have some influence on the infestation of a plant by thrips. Experiments were carried out to determine the effect of different types of soil on the infestation of the cotton plant by *Thrips tabaci*. The types of soil used in the experiments were a heavy clay soil and a light soil with less than 15 per cent. of clay, about fifty pots being filled with each type. Each block of fifty plants was divided into two, and the soil in one half was tilled while in the other it was left undisturbed. It was found that the plants in the block with untilled clay soil were

least infested by *T. tabaci*, while the plants in the block with light, tilled soil were the most highly infested. The average infestation of the two blocks with light soil was slightly higher than the average infestation of the clay soil blocks, in spite of the fact that at the beginning of the season the former blocks of plants and the thrips on them suffered severely from a sudden great rise in temperature. In both types of soil the block with tilled soil was more highly infested than the other block. It appears from these experiments that light soil is more favourable to the multiplication of soil pupating species of thrips than an easily caking, clay soil, and that tilling the soil increases the infestation by these insects.

361. Biology of the Mexican Cotton Boll-Weevil. IV. Duration of Fertility after Copulation. By E. F. Grossman. (*Flor. Ent.*, xiii., **3**, pp. 41-43, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **3**, 1930, p. 115.) Females of *Anthonomus grandis*, Boh. (cotton boll-weevil), were isolated after mating and kept for various periods in artificial hibernating quarters at a temperature of 55° F. They were then placed on fresh cotton squares in an incubator at 80° F. Fertile eggs were laid after periods up to almost seven months after mating had occurred.

362. The Biology of the Cotton Boll-Weevil. By F. A. Fenton and E. W. Dunnam. (*Int. Cot. Bull.*, viii., **31**, 1930, p. 470.) The authors state that climate exerts a very important influence on the seasonal cycle of the cotton boll-weevil at Florence, S.C. Unusually low temperatures, such as 11° F. or lower, appear to be unfavourable for the over-wintering weevils. Hot, dry summers, as experienced in 1925 and 1926, are also unfavourable. The frequency of rains, as well as the total rainfall, has an important bearing on boll-weevil development.

After being punctured once, a square remained on the plant on an average 7·35 days. When given their preference, weevils never punctured squares less than six days old for egg deposition. The younger the boll, the greater the average number of feeding punctures made by weevils in a twenty-four hour period.

In two varieties of short-staple and one of long-staple Upland cotton, more egg punctures per boll were made in bolls from six to twenty days old than in those one to five days old, but after twenty days the number per boll dropped steadily. For these same varieties the average cotton loss, in terms of locks damaged or destroyed, was highest in bolls one to five days old, and it dropped rapidly for all three varieties until the bolls opened.

363. Anti-Weevil Parasite. (*Text. Rec.*, xlvii., **565**, 1930, p. 78.) "Associate Professor of Botany at the University of Georgia, Julian H. Miller, together with his colleagues, tells of the discovery of a minute wasp, reported before as being found in Texas and Oklahoma, which destroys the boll weevil. The life-history is briefly as follows: Adult wasps appear about the time the weevil begins activity in the early summer. They lay eggs in the hole in which the weevil has deposited its egg, either in square or boll. The parasite larva, on hatching, bores into the weevil larva and eats it up. It is strictly carnivorous and will not eat cotton. After this feeding period it goes into the nymphal stage and emerges as an adult. The life-history takes about twelve days for completion in the middle of the summer."

364. Mexican Cotton Boll-Weevil: Distribution. By G. A. Bieberdorf. (*Biol. Abs.*, 4, 1930, p. 175. Abstr. from *Summ. of Curr. Lit.*, x., **8**, 1930, p. 179.) The early history of this insect, its entrance into the U.S.A., and its rapid dissemination in Texas, are briefly reviewed. Its distribution in Oklahoma is traced from the time of its discovery north of the Red River.

365. Arrivera-t-on a Supprimer Radicalement le Ver Rose. By J. Muhlberg. (*Bull. Un. Agr. Egypte*, No. 203, Cairo, 1929. Abstr. from *Rev. App.*

Ent., xviii., Ser. A, 4, 1930, p. 196.) In the hope of securing control of *Platyedra* (*Gelechia*) *gossypiella*, Saund., in the Nile Delta region, the author suggests that the fumigation of cotton stalks, which are kept on the roofs of Egyptian dwellings for use as fuel, and provide hibernation quarters for large numbers of larvæ, should be made compulsory and, if possible, carried out at the expense of the Government. He believes that the taxes collected on the increased returns secured thereby from the cotton plantations would amply cover the cost.

366. THE BOLLWORM OR CORN EAR-WORM AS A COTTON PEST. By F. C. Bishopp. (*U.S. Dept. Agr. Farmers' Bull.* 1595, 1929. Abstr. from *Exp. Sta. Rec.*, 61, 8, 1929, p. 756.) This is a revision of and supersedes in part Farmers' Bulletin 872.

367. UNA PALOMILLA (*Stenoma crambina*, Busck) COMO UNA NUEVA PLAGA DEL ALGODON EN EL ESTADO DE OAXACA. (*S. crambina* AS A NEW PEST OF COTTON IN THE STATE OF OAXACA, MEXICO.) By A. Busck and A. Dampf. (*Estud. Ofic. Fed. Defensa Agric. Mexico*, No. 2, San Jacinto, D.F., 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, 4, 1930, p. 138.) The first part of the paper is by Busck and contains his original description of *Stenoma crambina*, with a Spanish translation. In the second part, Dampf describes the larva and pupa, and gives the results of observations on this moth on cotton in the Mexican State of Oaxaca in 1929. The larva mines in the bark, both of slender twigs and stems 3 inches thick. Pupation takes place in a groove in the bark, under a shelter formed of silk and excreta.

368. A STUDY OF THE COTTON FLEA HOPPER, *Psallus seriatus* Reut., WITH ESPECIAL REFERENCE TO ITS EFFECT ON COTTON PLANT TISSUES. By R. H. Painter. (*Jour. of Agr. Res.*, vol. xl., No. 6, 1930, p. 485.) The primary purpose of this study is in the nature of foundation work for future studies. The anatomy and histology of the alimentary canal of the cotton flea hopper, *Psallus seriatus*, are given. The structure of the salivary glands and their accessory glands and ducts has been worked out, together with the structure of the mouth parts. The presence of bodies which may be parasites in the anterior part of the salivary gland is discussed.

The effect of the feeding of the cotton flea hopper on the plant cells has been described, and a study of the tissues of infested cotton has shown, in addition to the malformations of the cells, the presence of cell inclusions near the site of the puncture. In certain preparations these cell inclusions have the appearance of an invading or developing parasite, and have been found in both fresh and preserved plant material.

The field experiments have shown that the inoculum or material injected by the cotton hopper does not spread far from the point of injury. The appearance of a systematic disturbance, sometimes observed in the infested fields, therefore, seems to be due to the multiplicity of bites, and the shedding of the cotton squares seems to be due to a bite near by.

The secondary purpose of the paper is to call attention to possible plant-disease transmission by *Psallus*, and to present the evidence that has been gathered.

369. THE COTTON-SQUARE BORER. By H. J. Reinhard. (*Bull. No.* 401, *Texas Agr. Exp. Sta.*, 1929.) *Strymon melinus* is one of the "hair-streak" butterflies, the larva of which commonly feeds upon cotton squares and is popularly known as the cotton-square borer. The distribution of the species extends over temperate North America. Although a very common species in Texas, this insect is not an especially injurious pest on cotton. Locally, the larvæ usually feed upon the seed pods of cowpeas, beans, okra, and to a lesser extent upon corn and goatweed (*Croton capitatus*).

The butterfly's wings expand about 1 inch, and are blackish-gray above and ash-gray with darker wavy streaks beneath. The hind wings bear two slender

tail-like prolongations, between the bases of which above and beneath are roundish black spots crowned with orange-red crescents. Adults of the over-wintering brood emerge during February and March, and oviposition begins soon thereafter, extending continuously throughout the warm season. The eggs are laid singly and promiscuously upon the food plants. The incubation period during June and July, 1928, averaged about five and a half days. The larvæ normally moult five times, and require about twenty days during warm weather to attain full growth. Pupation occurs in the open, usually upon the food plant, and approximately nine and a half days are required for pupal development during the summer months.

Rearing records indicate that three complete generations or broods of the cotton-square borer may be produced during a season. In this latitude the insect does not pass through a protracted hibernation period. It is dormant or semi-dormant throughout December and January. This period apparently is passed in both the pupal and the adult stage. Usually the cotton-square borer is effectively held in check by natural enemies and combative measures rarely are required. When the use of the latter appear necessary, dry applications of calcium arsenate, 5 to 7 lb. per acre, will produce a satisfactory control, especially if the poison is applied when most of the larvæ are still small.

870. TSETSE-FLY RESEARCH. (*Co-ord. Rpt. No.* 2, Tanganyika Territory, 1930.) A report of progress made in connection with tsetse-fly research from March to August, 1929, and an outline of the programme projected for the period September 1, 1929, to February 28, 1930.

871. UEBER EINE NEUE MUSCIDE, DIE ALS PARASIT IN *Locusta migratoria* L., AUFTRITT. By A. A. Shtakel'berg. (In Russian and German.) (*Izv. prikl. Ent.*, iv., 1, pp. 121-129, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, 3, 1930, p. 128.) A description is given of a Muscoid fly, *Acridomyia sacharovi*, gen. et sp. n., which is parasitic on *Locusta migratoria* L., in various parts of south-eastern Russia and Central Asia.

872. THE ECONOMIC IMPORTANCE OF BIRDS IN UGANDA AND PARTS OF KENYA COLONY FROM THE POINT OF VIEW OF LOCUST DESTRUCTION. By C. R. S. Pitman. (*Bull. Soc. Roy. Ent. Egypte.*, 1929, Nos. 1-3, pp. 93-103. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, 3, 1930, p. 102.) From mid-February to April 20, 1929, while touring the districts of Gulu and Lango (Uganda), the author made observations on birds feeding on locusts that were invading the country. Of the resident birds the marabout stork (*Leptoptilos crumeniferus*) and vultures (*Pseudogyps* and *Necrosyrtes*) destroy considerable numbers of locusts. The migrants that are of most importance in this respect are storks (*Ciconia* and *Sphenorynchus*), kites (*Milvus*), the desert buzzard (*Buteo vulpinus*), and bee-eaters (*Merops* spp.). Particulars are given as to the habits of these species, as well as a few general notes on other birds observed feeding on locusts. The maximum destruction of locusts is caused by birds between September 1 and April 30, for this is the period when the southern and northern passages of Palæarctic and north Ethiopian migrants and the breeding of resident storks, vultures, etc., take place.

873. THE LOCUST PROBLEM IN EGYPT AND ITS RELATION WITH OTHER COUNTRIES. By A. M. Mistikawy. (*Bull. Soc. Roy. Ent. Egypte*, 1929, 1-3, pp. 29-41. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, 3, 1930, p. 101.) The author outlines the general distribution of *Schistocerca gregaria*, Forsk., and reviews its recent invasions of Egypt, which took place in 1891, 1904, 1914, 1915, 1927, and 1928. There is no direct evidence that it breeds constantly in Egypt; it has three principal breeding centres—viz., the eastern, which lies in Arabia, probably in Nejd; the central, in the eastern Sudan, Eritrea, and Abyssinia; and the western,

in the north-western Sudan. The routes followed by the locusts migrating from these centres are discussed; Egypt lies in the way of most serious migrations, and its locust problem is linked up with that of the surrounding countries.

The locusts have been bred in cages for two successive generations, some crowded in one cage, others kept singly. The adults in both cases behaved in a manner characteristic of *S. gregaria* ph. *solitaria* (*flaviventris*, Burm.), and the author concludes that crowding is not the only factor determining the transition from one phase to another. Females have been observed to oviposit from three to seven times; from laboratory studies the author is inclined to believe that *S. gregaria* has three generations a year.

In control experiments, successful results were obtained with flame throwers, contact sprays of pyrethrum soap or fish-oil emulsion, poison baits, and heavy dusting with sodium fluosilicate.

374. A Study on Flies Parasitic on the Asiatic Locust (*Locusta migratoria* L.) and their Super-Parasites. Part I.: Parasites of the Larvæ and Full-Grown Insects. By N. G. Olsuf'ev. (In Russian, with a summary in English.) (*Izv. prikl. Ent.*, iv., **1**, pp. 61-120, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **3**, 1930, p. 128.) An account of observations carried out in 1927 and 1928 on *Blæsoxipha filipjevi*, Rohd., in Daghestan, and *B. lineata*, Fall., *B. grylloctona*, Lw., and *Acridomyia sacharovi*, Stack., in Daghestan and Kazakstan (Central Asia), where these flies aré parasitic on *Locusta migratoria* L., and other Acridids, with descriptions of the larval and adult stages. All four species are themselves parasitized by *Brachymeria* (*Chalcis*) *dalmani*, Thoms., which is also described in detail.

375. Intracellular Bodies in Plant Virus Diseases. By F. M. L. Sheffield and J. Henderson Smith. (*Nature*, February 8, 1930. Reprint received from Dept. of Mycology, Rothamsted Experimental Station, Harpenden, Herts.) It has been known since 1903, when Iwanowski's paper on tobacco mosaic appeared, that virus disease in plants is frequently accompanied by the appearance within the cells of abnormal inclusions bearing some resemblance to amœbæ. These inclusions, or "X-bodies," are well-defined masses of granular or finely reticulated material not unlike protoplasm, typically rounded or roughly spherical in shape, though often elongated, and usually containing in their substance vacuoles, which vary in number from one to as many as ten or eleven. The resemblance to amœbæ is heightened by the not infrequent appearance of lateral projections suggesting pseudopodia, and the occurrence of bodies constricted in such a fashion as to suggest fission has led several observers to believe that these X-bodies are in fact living organisms or plasmodial colonies of organisms, which represent some stage in the life-history of the virus parasite.

An account is then given of the work on the subject carried out by the authors, and it is stated in conclusion that "The possibility that they are cytoplasmic condensations is strengthened by the fact that X-bodies are protein in nature. They give the usual protein reactions, such as Millon, Raspail, biuret, and various aldehyde tests; they are soluble in acid and alkali of sufficient strength, insoluble on boiling and in alcohol. They have a distinct tendency to crystallize out, especially in old leaves, and the crystals have all the characters of protein crystals, such as are seen in aleurone grains, including the tendency to take semi-crystalline forms with faces and angles on only part of their surface. In polarized light these crystals do not appear, nor does the uncrystallized body, though sometimes one or two small doubly-refracting crystals may be seen lying on the surface of the body or embedded in its substance."

376. Administration Report of the Government Mycologist, Coimbatore, for 1928-29. By S. Sundararaman. (*Rpt. Dpt. of Agr. Madras Presidency*,

1928-29. Abstr. from *Rev. App. Mycol.*, ix., **2**, 1930, p. 87.) Further studies have been carried out on the cotton (*Gossypium herbaceum*) boll rot and seedling blight associated with the fungus formerly referred to as *Vermicularia*, but now regarded as more correctly named *Colletotrichum*. The optimum temperature for growth is between 30° and 35° C., with a minimum below 17° and maximum at 52°, while the optimum hydrogen-ion concentration for growth was pH5, and for sporulation 5·5. Saltation was observed on certain media. The organism was found in the seed coats in a viable condition. Better control of the disease was given by two applications of Bordeaux mixture to the seedlings than by seed treatment with sulphuric acid or a combination of the two treatments.

877. Report on the Second Imperial Mycological Conference, 1929. (*Colonial No.* 45, 1930; pubd. H.M. Stationery Office; price 1s. 6d. net.) Among the subjects discussed at the Conference were the following: The existing organization of plant pathological (plant protection) services in various parts of the Empire; Virus diseases; Seed-borne diseases; Legislation governing the export and import of seeds; The control of insect pests by entomogenous fungi, with special reference to island conditions.

878. Macrophomina phaseoli (Maubl.), Ashby, and Rhizoctonia bataticola (Taub.) Butler. By J. C. Haigh. (*Anns. of Roy. Bot. Gardens*, Peradeniya, Ceylon, xi., **3**, 1930, p. 213.) Twenty-seven strains of *Macrophomina phaseoli* (Maubl.), Ashby (=*Rhizoctonia bataticola* (Taub.) Butler), have been examined and have been divided into three groups by mean sclerotial size in culture. The groups are distinct and readily distinguishable one from another.

Considerable variation has been shown by members of the smallest (or C) group, but differences are diverse in character and cannot be correlated. Pycnidia of *Macrophomina phaseoli* have so far been connected only with the smallest group, and it is considered possible that the other groups may have distinct perfect stages. Until some knowledge is obtained of the higher stages of the A and B forms, however, it is advisable on morphological grounds to retain the present arrangement, whereby all three groups are regarded as forms of one species and are called *Rhizoctonia bataticola*.

There has arisen by saltation a form which gives pycnidia of *Macrophomina phaseoli* in culture, either with or without sclerotia. This form produces a rot of sweet potato tubers similar to charcoal rot, with the production of either pycnidia or sclerotia in the tissues of the host.

The fungus *Macrophomina phaseoli* has been shown to be extremely plastic in culture. It may be that a similar plasticity in its pathological action will account for the inconsistency of experimental results obtained by the present writer and others.

879. Ascochyta Blight of Cotton. By O. C. Boyd. (*Plant Disease Reporter*, xiii., **6**, 1929. Abstr. from *Rev. App. Mycol.*, ix., **2**, 1930, p. 107.) The cotton crops in South Carolina and northern Georgia have suffered heavy damage during the current season from the blight due to *Ascochyta gossypii*. In Oconee County, South Carolina, all the twenty-five fields inspected contained some infected plants (100 per cent. in one case showed leaf or stem lesions, with 4 per cent. dead). In Haversham County, Georgia, the losses from seedling blight and destruction of the tops of older plants ranged from 10 to 50 per cent. Leaf spots and cankers were prevalent on the new growth replacing the blighted shoots. The disease is reported to have accompanied and followed a protracted rainy period ending about July 10.

880. Studies of Cotton Root-Rot at Greenville, Texas. By H. C. McNamara and D. C. Hooton. (*U.S. Dpt. Agr. Circ.* 85, 1929, p. 16. Abstr. from *Exp. Sta. Rec.*, 62, **5**, 1930, p. 443.) Careful inspection over the eight-year

period 1920-1927 of infected areas on the field plats of the cotton-breeding station at Greenville, Texas, showed that the spread of the root-rot infection was due to the expansion of the original areas rather than to the development of new areas. Where cotton was grown continuously the infected areas increased about threefold in size in the eight years. The disease apparently spread across rows at about the same rate as along the row, and no indication was seen that tillage practices spread the infection. In the circle of infection the border plants were usually the first to succumb.

Concerning the depth to which the organism penetrates the soil, active mycelium was found on cotton roots down to 26 in., but it is thought that the major infection occurs within the upper 15 in. The progress of the disease was stopped by a narrow trench 24 in. in depth, but a 12-in. excavation was not fully successful. Clean fallow over a two-year period gave promising control results, but one year's fallow sufficed only to delay the onset of the disease. A combination of fallow and of non-susceptible crops is believed promising. The fruitage stage of the root-rot fungus was apparently rarely attained at Greenville. In 1926, following a humid summer and fall, there was a heavy production of spores.

381. Plants Susceptible or Resistant to Cotton Root-Rot and their Relation to Control. By J. J. Taubenhaus, *et al.* (*Bull. No.* 393, Texas Agr. Exp. Stat., 1929.) A State-wide survey of species of plants subject to root rot has been carried on during a period of several years. Both cultivated and non-cultivated plants have been examined for symptoms. Final diagnosis has been based on the presence of the parasite on the root systems. The plants designated as resistant have either been specially treated and found resistant or have remained healthy in locations where root rot was destructive.

Among the cultivated plants there are many showing high susceptibility. These include many of the important field crops, tree and bush fruits, ornamental trees, shrubs, and vegetables. 274 cultivated species are listed as susceptible. The list includes cotton, legumes, apples, pears, peaches, figs, elms, locusts, cottonwoods, poplars, spruces, pines, roses, spireas, privets, carrots, beets, turnips, sweet potatoes, beans, grapes, and blackberries. Marked resistance is shown by members of the melon, onion, lily, mint, asparagus, and grass families.

Of non-cultivated plants, the susceptible species number 244, while 66 others are listed as resistant. Weeds such as the common tievine, soft groundcherry, and Solanum species are susceptible, and, because of their perennial nature, are important carriers of root rot. Distinct resistance is exhibited by representatives of the geranium, verbena, buttercup, and mint families.

Native vegetation, in the limited number of cases studied, has carried root rot and apparently has been the source of the disease in the first crop grown after the breaking of the land. Susceptible species in fence-rows, waste places, and meadows were found to be infected, indicating that the fungus may be carried over from year to year on weeds in these locations.

The total number of susceptible species is very large, some 527 species being named in the Tables. This large range of host plants makes the disease extremely important; moreover, when the value of the economic species attacked is considered, it is evident that root rot should be considered one of the most serious plant diseases known to science.

382. Cotton Wilt. By J. F. Dastur. (*Mems. of Dpt. of Agr. in India*, Botan. Ser., xvii., 3, 1929.) *Summary:* A description of cotton wilt in the Central Provinces and Berar is given. The microscopic, macroscopic, and microchemical characters are very significant in identifying the disease and distinguishing it from seedling blight, caused by *Rhizoctonia*, which is a very common and serious disease of seedlings. It is shown that wilt-affected plants have the same internal

symptoms as the mature healthy plants growing in diseased soil. *Fusarium* hyphæ are not necessarily always found in wilt-affected plants, but have been found at times even in healthy plants. There are some important points of difference between the cotton wilt under study and the American and Egyptian wilts. Application of lime to infected soils has had no immediate or residual effect on the incidence of the disease, but applications of superphosphate appear to have some residual effect. Uspulun—dry or wet—when applied in large quantities to wilt-affected soil, controls the incidence of the disease, but in small quantities it has no effect. The incidence of wilt is influenced either by the relative positions of wilt-affected and healthy soils in layers in a pot or by the proportion of wilt-affected soil mixed with healthy soil. It would appear that the size of pots containing wilted soil in which plants are grown has some influence on the incidence of the disease.

Fusarium Strain A, commonly found in wilted plants, is present both in wilted and healthy soils in these Provinces. Inoculation experiments have shown that this fungus is not parasitic. Plants grown in healthy soil which is mixed with short lengths of stems of wilted cotton plants of the previous season become wilted, but the disease is also produced in plants, though to a much less extent, when the soil is mixed with healthy stems instead of diseased stems. In healthy soil which is mixed with healthy cotton stems of the previous season, and on which is cultured *Fusarium* Strain A, plants do not develop more wilt than in healthy soil mixed with uninoculated healthy cotton stems. When single pieces of wilted cotton stems are planted in healthy soil along with each seed, there are no cases of wilt. Wilt can be developed in a healthy soil by non-pathogenic agencies, such as by treating it with heavy doses of organic manure or lime or with salts of aluminium or by keeping the soil water-logged. Typical wilt symptoms—macroscopic, microscopic, and microchemical—can be produced in healthy plants growing in a " non-wilted " soil by injecting them with aluminium salt solutions; *Fusarium* Strain A was found in those of the injected plants which were left in the soil for a long time after they had wilted. The disease is not induced in plants injected with water containing spores of *Fusarium* Strain A, or with filtrates of *Fusarium* Strain A cultivated on Richard's solution. Plants grown in a wilt-affected soil, dry sterilized at 150° C. or 140° C., remain free from infection, but if grown in " wilted " soil sterilized at 120° C. they are liable to become infected. *Jowar* (*Sorghum*) appears to have some influence in controlling wilt. Seedlings in very early stages of wilt infection, if transplanted to healthy soil, develop into healthy mature plants, though *Fusarium* Strain A has been found to be viable in these mature plants. Plants grown in Knop's solution become wilt affected if aluminium salts are added to the solution, but remain healthy if only spores of *Fusarium* Strain A are added to it. Staling experiments have shown that cotton plants are susceptible to the toxic effects of several *Fusaria* and other fungi. It is suggested that aluminium salts are present in tissues of wilt-affected plants, and wholly or partially fill the cell lumen.

383. La " Marchitez " del Algodon. By E. V. Abbott. (*Circ. No.* 15, Estacion Exp. Agr. de la Soc. Nac. Agraria, Lima, Peru, 1929.) Deals with the injury caused by, and the measures of control for, the " Marchitez " (*Fusarium vasinfectum*), the most important fungus attacking cotton on the coast of Peru.

GENERAL BOTANY, BREEDING, ETC.

384. Cotton Nutrition. (*42nd Ann. Rpt. Ga. Exp. Sta.*, 1929, p. 23.) In a comparative study of ammonium sulphate and potassium nitrate as sources of nitrogen for the cotton plant in water culture, practically no difference was found

in the green weight, dry weight, or height of plants grown for six weeks on the two forms of nitrogen.

No difference was found in the reaction of the expressed sap of plants grown on the two forms of nitrogen at either three or six weeks of age, though a slight difference in buffer properties was observed. The concentration of nitrate nitrogen in the sap of plants three and six weeks old, grown in the nitrate solution, was much higher than the concentration of ammonia nitrogen in the sap of plants grown in the ammonia solution.

Analysis of the plants at the end of the growth period indicated that the introduction of the basic ammonia ion into the culture solution as a source of nitrogen in place of the acid nitrate ion slightly increased the absorption of phosphates and possibly sulphates, but depressed the absorption of the other principal bases, especially calcium and magnesium, the nitrate plants containing 100 per cent. more calcium and 60 per cent. more magnesium.

The solutions used had a high potassium concentration and the absorption of this element was very heavy. Associated with this high potassium absorption was a tendency of the growing plants to increase the H-ion concentration of the nitrate solution.

385. AUTOMATIC PLANT-WATERING SYSTEM. R. A. Steinberg. (*J. Agr. Res.*, **40**, 1930, 233-41. Abstr. from *Summ. of Curr. Lit.*, x., **7**, 1930, p. 168.) A fully automatic watering system that can be used with or without a recorder in indoor or outdoor studies of plant transpiration and growth is described. The essential component of the apparatus is a swinging or rocking funnel through which a stream of water flows at a constant rate. This stream is diverted into a plant container for almost exactly one minute whenever the loss in weight of the container causes the beam of the balance on which it rests to close an electrical contact. The current which operates the funnel also moves a magnetically operated pen over a moving time chart, thus producing a permanent record. The quantity of water added is then equal to the flow of water per minute, multiplied by the number of times the funnel has been actuated as indicated by the chart.

386. AGRICULTURAL METEOROLOGY IN ITS PLANT PHYSIOLOGICAL RELATIONSHIPS. By V. H. Blackman, F.R.S. (Conf. of Emp. Meteorologists, 1929. *Papers and Discussions*, p. 21.) The general conclusion may be drawn that the ordinary meteorological data of temperature and humidity are adequate for plant physiological purposes, though soil temperatures and humidity as well as air temperatures are required for the fuller study of the plant's reaction to these climatic factors. With regard to light, what is required is a measure of total radiation or, what would be still better, some measure of brightness and its variation during the day. The plant is certainly affected by light quality as well as light intensity, so that as our knowledge increases there will be need for a record at different localities of the energy distribution throughout the spectrum and its changes during the day.

387. APPARATUS FOR THE GROWING OF PLANTS IN A CONTROLLED ENVIRONMENT. By R. H. Stoughton. (*Annals of App. Biology*, xvii., **1**, 1930, p. 90.) An account is given of the construction of tanks and chambers for the growing of plants under independently controlled soil and air conditions. The plants are grown in soil tins sunk in a water tank, the temperature of which is automatically controlled. Double-walled glass chambers fit over the tanks, and within these the conditions of temperature and humidity are independently controlled. Artificial illumination is provided by two flood-lights over each chamber, with 500-watt gas-filled lamps in each providing an illumination of the order of 1,000 foot-candles. The chambers were erected under a grant from the Empire Marketing Board for research on the bacterial disease of cotton.

388. ABSCISSION IN COTTON FLOWERS. By C. P. Dutt. (*Bot. Gaz.*, lxxxv., **2**, 1928, pp. 208-20. Abstr. from *Exp. Sta. Rec.*, lxii., **2**, 1930, p. 123.) Abscission of the cotton bloom occurs usually at or near the base of the internode, sometimes in the middle, the position of the abscission zone usually being indicated by a groove or surface depression, except in the case of very young material. The abscission zone consists of from 10 to 12 rows of cells. The separation layer, located near the upper (distal) region of the abscission zone, consists of 1 to 2 cell layers, and is formed by the chemical dissolution of the cell walls. No evidence of cell division appears in the abscission zone of the cotton bloom. All the tissues across the pedicel except the tracheal tubes function in abscission. The first visible indication of abscission is the swelling of the cell walls, and this is followed by their partial solution. Prior to abscission starch in large quantity is stored in the abscission zone, disappearing later during the development of the zone.

389. NOTE ON POLLEN GRAINS OF COTTON. By Trevor Trought. (*Agr. J. of India*, xxv., **1**, 1930, p. 26.) A method of staining the pollen grains of cotton, which enables the pores to be counted, is described in detail. Observations on pore number in different varieties, pollen-grain diameter, and the total number of pollen grains in individual anthers were made.

390. VARIETAL AND SEASONAL VARIATION OF "MOTES" IN UPLAND COTTON. By H. E. Rea. (*J. Amer. Soc. Agron.*, xxi., **4**, 1929, pp. 481-6. Abstr. from *Exp. Sta. Rec.*, lxi., **9**, 1929, p. 826.) In a second study the percentage of motes was determined for sixteen commercial varieties of cotton grown at the Temple, Texas, Substation in 1925 and 1926. Of 1,323 plants examined only two lacked motes. The percentage of motes ranged from 14·7 per cent. for Sunshine in 1926 to 47·4 per cent. for Durango in 1925. Seasonal conditions seemed to account for a wide variation in the percentage of motes produced. The year 1925 was much drier than 1926; 75 per cent. of the varieties studied showed significantly higher percentages of motes in the former than in the latter year.
[*Cf.* Abstract **423**, Vol. VI., p. 282.]

391. HAIRY BOLLS AND NECTARIES IN A HYBRID COTTON. By R. H. Peebles. (*J. Hered.*, 20, **7**, 1929, pp. 340-7. Abstr. from *Exp. Sta. Rec.*, 61, **9**, 1929, p. 826.) Pronounced pubescence observed in a progeny of Pima × College cotton is described, and comment made on the occurrence of intracarpellary hairs in different cottons. Examination of intracarpellary hairs in Pima × Acala F_2 progenies showed hairiness dominant, with indications of two factors involved.

392. VARIATION IN LINT LENGTH IN COTTON. By V. Ramanatha Ayyar and G. Jagannatha Rao. (*Agr. J. of India*, xxv., **1**, 1930, p. 42.) It is shown in this paper that (1) there are definite differences in the lint lengths of seeds produced in different pickings; (2) there is no definite relation between lint length and the date of picking; (3) there is no significant variation in lint length between lock and lock in the same boll; (4) the topmost seed has the shortest staple, and there may be in certain strains differences in lint lengths of seeds according to their position in the lock; (5) the lint length on the right side of the seed is greater than that on the left.

3. STUDIES IN INHERITANCE IN COTTON. By M. Afzal. (*Mems. of the Dpt. of Agr. in India*, Bot. Ser., vol. xvii., **4**, 1930.) The mode of inheritance of nine characters was worked out in a cross between *G. cernuum* and *G. indicum* (Burma Silky). *G. cernuum* had shallow broad-lobed leaves, long bracts, petals and bolls, very short lint and very high lint index and seed weight. Burma Silky had shallow broad-lobed leaves, short bracts, petals and bolls, long lint and low lint index and seed weight. The F_1 did not show heterosis except in the case of

length of petiole. In the case of leaf factor, leaf-lobe index, index of lowest sinus-breadth, length of bracts, length of petals, length of bolls and seed index, the F_1 was intermediate, while a tendency to dominance of Burma Silky parent was shown in the case of width of bolls and length of lint, and of the *Cernuum* parent in the case of lint index. The depth of laciniation was inherited in a simple manner. The length and breadth of bracts showed very little splitting in the F_3, while the rest of the characters were very much complicated. From the correlations worked out, it was noticed that the length of lint was inherited independently of lint index and seed index, and that lint index was very highly correlated with seed index. It would therefore seem quite possible to combine these three highly desirable characters.

394. THE USE OF SELFED SEED IN MAINTAINING THE PURITY OF IMPROVED COTTONS. By G. L. Kottur. (*Agr. J. of India*, xxv., 1, 1930, p. 39.) The following is a simple and efficient method of selfing cotton flowers by the use of rings, in practice at Dharwar. "The rings are easily made of galvanized iron wire (20 in.), which is sold at Rs. 20 per cwt. The wire is coiled on a hand-reeling machine, using different rods for different cottons. These coils, when cut, give the rings. For most of the Indian varieties rings of 6 mm. in diameter are suitable, while American cottons require larger ones, according to the size of their buds. All that is needed for preventing crossing is to slip these rings on the buds some time before they begin to open. A piece of cotton thread which is attached to the rings is tied to the pedicels. When the petals drop the rings hang on the pedicels, and this enables the pickers to distinguish the selfed bolls from the non-selfed. The procedure is so simple that a girl can easily handle about 1,000 buds in one morning.

"The rings remain firmly on the tips and do not allow the petals to expand. They come off only when the flowers shrivel on the third or fourth day. Pollination takes place inside the cone without any trouble or disturbance. Ringing has no disadvantage; on the contrary, it protects the pollen during the wet weather, when the percentage of successful bolls is always greater from ringed flowers. The method is easy, safe and effective, and can be conveniently employed for producing large quantities of selfed seed." 60 to 100 lb. of selfed seed of Dharwar I. are produced every year at an extra cost of Rs. 2·12 per pound. As 3 lb. of seed are generally required to dibble one acre, absolute purity of cotton can be secured at an extra expenditure of Rs. 6 per acre. In this way 6,000 to 9,000 lb. of pure seed is raised on the Government Farm at Dharwar and distributed to selected seed-growers for further multiplication. The produce of the seed-growers, which is collected and ginned under the careful supervision of the departmental officers, is sufficient to drill 10/15,000 acres. Care is taken to secure this area in one or two blocks situated near the central cotton markets. Seed multiplied on these blocks is purchased by the cotton societies for general distribution in the tract. It covers annually about 200,000 acres, which is the limit under the existing arrangements for supervision. The farm seed is distributed to seed-growers every year, and the produce of the growers reaches the owners in the blocks. In this way a regular fresh supply is maintained.

395. COTTON NOTES. By S. C. Harland. (*Trop. Agriculture*, vii., 5, 1930, p. 132.) *Natural Crossing and the Preservation of Pure Lines in Cotton.* It is pointed out that the "elementary species" of de Vries, or "biotypes" of Johannsen, only occur in normally self-fertilizing plants, but that a number of pure lines have now become established in cotton in various places. Even in such cases, however, mutation may occur, and lead to crossing with undesirable types; but this is a small risk compared with that of contamination by natural crossing, which occurs in so many places. The paper ends with a summary of the results obtained by Balls and his co-workers.

[*Cf.* Abstract **393** above.]

396. A New Cotton from the Southern Division, Bombay. (*Times of India*, April 4, 1930.) The Bombay Department of Agriculture has produced a new cotton, a hybrid of Dharwar I. with Dharwar II., to which the name of "Jayawant" cotton has been given. The new strain was bred by Rao Sahib Kottur, the Cotton Breeder in the Southern Division, and in addition to producing a good lint it has high wilt-resisting qualities. A proposal is now pending for the rapid extension of the cotton in the Southern Division, and if the necessary funds can be arranged it should be doubled in the territory in the next year.

FIBRE, YARNS, SPINNING, WEAVING, ETC.

397. N.W.K. Universal Fibre Meter. By H. Meyer. (*Leipziger Monats. Text. Ind.*, **44**, 1929, 460-75 and 517-22. *Summ. of Curr. Lit.*, x., **4**, 1930, p. 71.) Methods for measuring the length, fineness, crimp, and strength and elasticity of fibres are critically surveyed, and a new method for determining fineness is described. The method is universal in that it can be applied to all fibres in any elementary form, and mean length of fibres as well as mean fineness can be determined. The apparatus consists essentially of a base plate which carries an adjustable cutting device at the left-hand side, a hinged microscope at the right-hand side, and between them a hard rubber block across which a fringe of fibres is stretched between forceps and an adjustable tensioning device. The hard rubber block is interchangeable, the width being varied according to the fibre length of the material under investigation, and each long edge has a blade the cutting edge of which is level with the surface of the block. These cutting edges co-operate with the blades of the adjustable cutting device, to which they are hinged at the left-hand side. In operation a thin, single-layer fringe of parallel laid fibres is prepared on one of the usual comb field sorters: the level ends are grasped by forceps, and the fringe is drawn through a comb that forms part of the tensioning device of the apparatus, during which process it is pressed down on the velvet surface of the block that supports the tensioning device and on the comb by a hinged lever. It is laid in place over a rubber block of suitable width, the free ends of the fringe are clamped down, the forceps are bolted in place, and the fibres are straightened out by carefully moving back the tension device and support by means of a micrometer screw. If mean fibre length is to be determined, the cutting device is swung over and the part of the fringe cut out is weighed. The ends of the fringe are also weighed, and the mean fibre length in mm. (L_m) is calculated from $L_m = .G.l_m/g_m$, where G is the weight in mg. of the whole fringe, g_m the weight of the middle piece, and l_m the length in mm. of the middle piece. For determining fineness a fringe is prepared in which the individual fibres are of the mean fibre length. This is fixed in the apparatus, the microscope is turned into position, and by means of a fine driving screw is caused to move across a bridge over the whole width of the fringe. A mechanical counting device facilitates the work of counting the fibres. It has three feelers, which indirectly actuate three columns of figures, and by its aid the fibres are classified as coarse, medium, and fine. The cross-wires in the ocular of the microscope serve as a standard for judging the fibres, and each fibre is registered as its examination is completed by pressure on the appropriate feeler. Subsequently the microscope is turned back on its hinge, the cutting device is brought into operation, and the cut tuft is weighed on a highly sensitive analytical balance, or, preferably, on a micro-balance. Fineness is calculated from $n=l.z/g$, where n is the fibre fineness number in mm. per mg., l is the length in mm. of the pieces of fibre cut out, z the number of pieces, and g their weight in mg. A quicker but less accurate measurement of fineness can be made on a single sample by first examining a fringe under the microscope, then cutting out the centre portion and weighing it alone and with the end portions. The calculation of mean diameter from mean fineness is shown.

398. A Comparison of some Methods of Testing the Breaking Strength of Single Cotton Fibres. By H. Navkal and K. R. Sen. (*Tech. Bull.*, Ser. B, No. 5, 1930. Indian Central Cotton Committee.) The present paper deals with the merits and demerits of three types of instruments which are used for the determination of the breaking strengths of single cotton fibres—viz., the hydrostatic (O'Neill's), the balance (Barratt's), and the pendulum (Balls' Magazine Hair Tester).

Various results are given for the different instruments. It is shown that the mean obtained by Barratt's is higher than that obtained by the other two, of which O'Neill's gives the higher value. Replacing the water in the latter instrument by calcium chloride, so as to regulate the humidity at which fibres are broken, lowers the mean and renders it but little different from that obtained by the Magazine Hair Tester. Results obtained at the Technological Laboratory for thirty-nine cottons tested on both the instruments are given, from which it is deduced that, on the average, the Magazine Tester gives a value which is only 2½ per cent. greater than O'Neill's; a part at least of this difference is attributed to the greater speed at which fibres are broken by the Magazine Tester.

The errors of the three instruments are discussed in detail.

399. Fibres: Identification. By A. Niethammer. (*Faserforschung*, 8, 1929, 121-123. Abstr. from *Summ. of Curr. Lit.*, x., 4, 1930, p. 71.) Two simple micro-chemical reactions for the identification of textile fibres and paper raw materials are briefly described. The first is based on the use of picrocarmine and the second on the use of cobalt thiocyanate. The colours given by cotton, flax, hemp, jute, ramie, various silks and rayons, sulphite and soda cellulose, and other fibres, with the two reagents and with acid fuchsin are indicated. Cotton gives a reddish-brown colour with picrocarmine, and is not affected by cobalt thiocyanate.

400. Plant Fibres: Structure. By M. Lüdtke. (*Papier-Fabr.*, 28, 1930; *Ver. Zellst. Ing.*, 129-133. Abstr. from *Summ. of Curr. Lit.*, x., 7, 1930, p. 169.) Plant fibres are divided into series of concentric cylinders by skins of furfuroid substances, and these are further divided by membranes radiating from the axes. Photomicrographs of wood, cotton, flax, and other fibres swollen in cuprammonium solution demonstrate the presence of such membrane or skin systems. The individual fibrillæ are often arranged spirally round the fibre axis. Swelling agents loosen the structure, and mercerization produces a contraction in length of the fibrillæ and an increase in width. The membranes become torn or dissolved by various swelling agents, and on strong swelling the arrangement of the fibrillæ is destroyed.

401. New Cotton Stapling Machine. (*Text. Rec.*, xlvii., 564, 1930, p. 85.) It is reported that a cotton fibre-sorting machine for separating fibres according to their length, and which gives promise of greater accuracy and ease of operation, is being developed by Dr. R. W. Webb, cotton technologist of the Bureau of Agricultural Economics, U.S. Department of Agriculture.

402. Cotton in Blow-Room: Moisture Content. By E. J. Hoxie *et al.* (*Trans. Nat. Assoc. Cotton Mnfrs., U.S.A.*, 1929, No. 124, 42-59. Abstr. from *J. of Text. Inst.*, xxi., 1, 1930, A. 14.) Over-moist cotton is becoming an increasingly important cause of scutcher fires. It causes fires by sticking together and packing about beamings in scutchers and condensers. Over-dry cotton was previously regarded as the chief factor in blow-room fires. Cotton with a moisture content of 8 to 8½ per cent. does not ignite. Some results are quoted of tests of the moisture content of Peeler cotton as received at the mill, and at the end of the scutching process. The figures indicate that the regain remains constant from the bale to the scutcher lap. Apparatus for making moisture tests on raw

cotton, yarns, and fabrics, and comprising a moisture-proof box containing a recording hygrometer, is described. The apparatus will not give accurate results, but it will give valuable information that can be obtained with the least amount of trouble and without extra labour.

403. TEXTILE FIBRES: REGAIN. By W. G. Schaposchnikoff. (*Textil.*, **11**, 1930, 113-6. Abstr. from *Summ. of Curr. Lit.*, x., **8**, 1930, p. 195.) The experimental results are tabulated, together with temperature, humidity, and pressure data, showing the state of the atmosphere throughout the period of the experiments; the course of the regain change, with fluctuations of temperature and humidity, is also shown in graphical form, and the results are discussed. They show the caution which should be used in extending conclusions from experiments in which fibres are dried in an artificial atmosphere. The conclusions from observations of fibres in a continuously changing atmosphere do not coincide with the ultimate results for the same fibre in the state of stable equilibrium. The moisture absorption of fibres varies greatly according to whether they are in a natural-labile or an artificial-stable atmosphere.

404. OPENING MACHINES: DESIGN AND EFFICIENCY. By T. Nuttall. (*Text. Mfr.*, 1929, **55**, 333-5. Abstr. from *J. of Text. Inst.*, xxi., **1**, 1930, A. 14.) A discussion, based on actual observations, of the cleaning efficiency of blowing room machinery, attempts to improve this efficiency, and the causes of stringing in scutcher beaters.

405. CRIGHTON OPENER: APPLICATION. By E. Kühne. (*Textilber.*, **11**, 1930, 2-3. Abstr. from *Summ. of Curr. Lit.*, x., **5**, 1930, p. 87.) In the author's opinion the modern Crighton opener is a valuable cleaning machine, and some of the improvements to which in part it owes its increasing application in blow-rooms are discussed. One of these is the Trützschler adjustable grid, which can be adjusted to the class of raw material and the degree of cleaning required by simple manipulation of a hand lever. The grid can be incorporated in existing machines.

406. COTTON: OPENING AND CLEANING. By T. Hagan. (*Trans. Nat. Asscn. Cotton Mnfrs., U.S.A.*, 1929, No. 124, 33-34. Abstr. from *J. of Text. Inst.*, xxi., **1**, 1930, A. 13.) The author's opinion of the typical opening-room equipment of today—namely, a bale breaker or two breakers in tandem, followed by a Buckley or lattice section and then by a vertical opener—is that it does not get the maximum " virtue " out of the cotton. Such an arrangement does not blend the cotton. Further, a Buckley section is a cleaning machine and the vertical opener is fundamentally not a cleaning but an opening machine, so that the arrangement attempts to clean cotton first and open it afterwards; in the author's opinion cotton should be opened completely before an effort is made to clean it. Again, a Buckley section is a low-production unit, and in the arrangement cited falls between two, comparatively speaking, high-production units, so that either the work of the high-production units is lessened or the low-production unit is forced too much. The Buckley beater is an excellent machine, but its place is in the scutching, not the opening room. The system of machines under consideration either takes too much cotton out of high-grade, or not enough dirt out of low-grade stock. The author is very strongly in favour of the adoption of a " double hopper system." In an eight-hopper system, three hoppers feed in parallel on to an endless belt conveyor, after which the cotton passes through a vertical opener and one or more cleaners, being fed from the last cleaner on to another endless belt conveyor on to which cotton from five other hoppers, also running in parallel, is dropped. The cotton then goes through another vertical opener and one or more cleaning machines. The cotton used in the first three hoppers is the low-grade cotton, that in four of the last five hoppers is the high-grade cotton, and the fifth hopper is used for reworked waste. The advantages of this

system over the bale-breaker system are that the low-grade cotton receives the special cleaning which it requires, the cotton is much better opened in the hoppers than in a large bale breaker, and is also opened up with a vertical opener before it is cleaned; and under this system cotton from sixteen bales at a time is blended instead of from three bales, as in a bale breaker. It is stated that some mills employing this system are successfully using cotton of much lower grades than is possible with the old system.

In the experience of a speaker in the subsequent discussion, the Buckley opener is both an opener and a cleaner, and if the machines are arranged in tandem for low-grade cotton with by-pass arrangements for higher grades and a series of dust trunks after leaving the Buckley machines, an ideal standard opening method can be obtained. In reply to a question on the curling of cotton, it was stated that a cause of curling in a vertical opener is that the cotton is allowed to remain too long in the machine.

407. Opening and Cleaning Machine. By Sté. Textile et Filature and G. Placquet. (*Revue Text.*, **27**, 1929, 1695-1697. Abstr. from *Summ. of Curr. Lit.*, x., **3**, 1930, p. 42.) The new type of cleaner for vegetable fibres consists of a cylindrical envelope in the centre of which is a shaft provided with arms in the form of light rods. These arms may be supplied with combs and the inner wall of the cylinder with spikes placed at small distances from the plane of rotation of the arms. The shaft turns at a low speed. In another form two shafts supplied with light arms are used, separated by a distance less than twice the length of the arms. The material is drawn up from the bottom of the cylinder by the rotating arms, and the seeds and fragments of leaf and other impurities separated by a kind of combing action. The opened material is carried from the upper part by means of a current of air and passes to a chamber, where the heavier impurities carried over are separated from the fibre by centrifugal forces, the fibre itself being carried away to a second chamber by the air current.

408. Raw Cotton: Oil Spraying. By H. L. Siever. (*Amer. Dyestuff Rep.*, **19**, 1930, 16-18. Abstr. from *Summ. of Curr. Lit.*, x., **4**, 1930, p. 62.) A report of a lecture on the advantages of spraying with "Breton Minerol E." Results of tests are mentioned, but no data recorded.

409. Oil-Treated *v.* Untreated Carded Cotton. (*Int. Cot. Bull.*, viii., **31**, 1930, p. 525.) The purpose of these tests was to compare the running qualities, waste (visible and invisible); cleanliness of the rooms and machines; end breakage on the roving frames, spinning frames and spoolers; breaking strength and counts of yarn The work was carried through two weeks of regular mill operation at the Erwin Cotton Mills, Cooleemee, N.C., and twenty bales of cotton $\frac{7}{8}$ to 1 in. middling grade were used. Approximately 5 oz. of oil were used to every 100 lb. of cotton.

The general results, which are given in comparative figures, were in favour of the oiled cotton.

410. Loom: New Inventions. By F. Chadwick. (*Text. Weekly*, **5**, 95-6, 1930. Abstr. from *Summ. of Curr. Lit.*, x., **8**, 1930, p. 187.) Recent inventions and improvements in loom design and construction, shedding, picking, beating-up and take-up motions, methods of driving, feeding and doffing, gaiting and downing, and inventions of shuttleless looms and looms for special purposes are reviewed.

411. Cotton-Spinning Notes and Calculations. By Dobson and Barlow, Ltd., Bolton. (*J. of Text. Inst.*, xxi., **1**, 1930, p. 16.) This compact little book, pocket size, comprises a useful collection of data for all engaged in cotton spinning. In an introductory note it is stated that the work is the outcome of constant

requests for details and information relating to cotton-spinning machinery. Over twenty years ago the firm issued a similar publication known as "The Students' Calculation Book," which proved popular amongst cotton-spinning students, managers, overlookers, and carders. No doubt many will be glad to have the new edition.

LEGISLATION.

412. NYASALAND. *Government Notice No.* 3 of January 9, 1930, gives rules for the planting and ginning of cotton and the storing of cotton seed.

413. TANGANYIKA TERRITORY. *Government Notice No.* 43 of March 12, 1930, deals with the Regulations covering the weighing of cotton bought from natives in the Territory.

TRADE, CO-OPERATION, ETC.

414. COTTON GOODS: EXTENDING USES. By F. Nasmith. (*Text. Weekly*, **5**, 1930, 27, 52, and 75. Abstr. from *Summ. of Curr. Lit.*, x., **8**, 1930, p. 188.) Increased propaganda and publicity on the lines of the recent Cotton Fair, and displays in overseas markets are recommended.

415. POINTERS FOR COTTON TRADE REVIVAL. By B. Ellinger. (*Indian Text. J.*, xl., **474**, 1930, p. 287.) Statistics are given of cotton exports, weavers employed and unemployed, power-looms at work, etc. The author states that the greatest need is to effect reduction in production costs.

416. THE BASIS OF PAYMENT FOR PRODUCE IN CO-OPERATIVE MARKETING ASSOCIATIONS IN THE UNITED STATES. (*Int. Rev. of Agr.*, Rome, xxi., **2**, 1930, p. 41.) *Cotton:* Originally all the large co-operative cotton-marketing associations determined the prices to be paid to members by averages taken over the whole season, but in recent years some of them have adopted various systems, leaving to the members the choice of the system under which their produce shall be sold. Thus a member may elect that the price to be paid for his produce shall be determined by the average price obtained for similar produce during the day on which it is sold. Or, again, some members may prefer that the prices paid for their produce should be determined by the average price obtained during a period of thirty days. In such cases the average taken is not the average price of *all* produce of the same grade and staple sold on the same day or during the same period, but the average price of the produce of the same grade and staple supplied by members who make the same choice of period. The shorter periods are adopted in order to meet the convenience of members who cannot wait until the end of the season for the final settlement of the price to be paid to them. The use of short periods is facilitated by the existence of the futures markets; it may not always be possible to make a spot sale, and in such case the association sells an equivalent quantity for future delivery. The most common practice is still to take the average price over the whole season as the basis of payment.

[And *cf.* Abstracts **420**, **421**, **422** below.]

MISCELLANEOUS AND ADDENDA.

417. COTTON FIELDS TO FINISHED PRODUCT. (*Text. Mercury*, March 7 and 21, 1930.) These articles continue the series mentioned in Abstract **287**. The first deals with the characteristics of cotton and buying methods; the second with the advantages of the double hopper bale breaker.

418. SCIENCE OF THE YEAR 1928: THE BIOLOGICAL SCIENCES. By W. B. Brierley. (Recd. from the Dept. of Mycology, Rothamsted Experimental Station, Harpenden,

Herts, 1930.) A very readable account of the general progress of biological science during the year, given under the heads of Evolution and Genetics; Zoology, General Physiology; Botany; Microbiology and Disease.

419. TEXTILE RECORDER YEAR BOOK, 1930. The 1930 edition contains new sections dealing with Knitting Machines for Hosiery; Winding of Rayon; Oiling Rayon Yarns; Trade Marks. Additions have also been made to the sections on Humidification and Ventilation, British Rayon Producers, and Production of Rayon. Other new features in the volume include a Bibliography of new Textile Machines brought into actual use in the industry during the year; a List of Holidays in the Textile Districts; Tables of Logarithms and Antilogarithms; new Tables of Statistics, etc.

420. LANCASHIRE COTTON INDUSTRY: COMPETITION. By A. Crickmore. (*Text. Weekly*, **4**, 1930, 549-552. Abstr. from *Summ. of Curr. Lit.*, x., **3**, 1930, p. 58.) The author states that in the matter of competition the most important factor is price, and any attempt to recapture lost trade must be based on the reduction of costs of production.

421. LANCASHIRE COTTON INDUSTRY: ECONOMIC PROBLEMS. By E. E. Canney. (*Text. Weekly*, 1929, **4**. Abstr. from *Summ. of Curr. Lit.*, x., **3**, 1930, p. 59.) Discusses, among other matters, the economic changes produced by the war, the effects of the return to the gold standard, the dependence of the cotton industry on contributory services such as banks, civil and municipal services, etc.

422. LANCASHIRE AND JAPANESE COTTON TRADES: COMPARISON. By B. and H. Ellinger. (*M/c. Guard. Comml.*, **20**, 1930, 90-91. Abstr. from *Summ. of Curr. Lit.*, x., **3**, 1930, p. 59.) Owing to the very efficient organization of the Japanese cotton industry great savings are effected by the elimination of commission and brokerage to intermediaries. Japan has a great advantage also in closer proximity to the Far East and in a lower rate of freight. A comparison of her organization with that of the British industry leads to the conclusion that, for the latter, the most pressing problem is the amalgamation of the small firms into larger units and the rationalization of the manufacturing and distributing sections.

423. THE COMPOSITION OF THE COTTON SEED PRODUCED IN NEW MEXICO. By C. W. Botkin. (*New Mexico Sta. Bull.* 175, 1929. Abstr. from *Exp. Sta. Rec.*, 61, **8**, 1929, p. 728.) Analyses of cotton seed of the Acala and other varieties grown in New Mexico in 1925, 1926, and 1927 are set forth in tables. Neither a pronounced seasonal variation nor a correlation with the quantity of irrigation water was observed. Immature seed contained less oil and protein than did mature seed. Mature seed of Acala cotton was rather uniform in quality during the three years, and did not vary materially in oil and protein during the picking season. The seed of Acala cotton was as high in oil and protein as any cotton analyzed, averaging 24·47 and 22·86 per cent. respectively for the three years. Available data from other regions suggest that the New Mexico seed would be among the highest in oil content, above average in protein, and average or less in gossypol.

424. STUDIES ON GOSSYPOL—V., VI. By E. P. Clark. (*J. Amer. Chem. Soc.*, 51, 1929, **5**, pp. 1475-1483. Abstr. from *Exp. Sta. Rec.*, 61, **9**, 1929, p. 802.) Deals with: V. The action of chromic acid upon some gossypol derivatives; VI. The action of boiling hydriodic acid as used in the Zeisel method upon gossypol and some of its derivatives.

425. CULTIVATION OF KAPOK. (*Leaflet No.* 52, Dpt. of Agr., Ceylon. Abstr. from *Trop. Agriculturist*, Ceylon, lxxiv., **2**, 1930, p. 110.) The yield is stated to average about 124 lb. per acre after three years, rising to 800 lb. after ten years.

Kapok is chiefly used for stuffing cushions, pillows, mattresses, etc. It is well adapted for this purpose on account of its lightness, its springy or resilient nature, and its non-hygroscopic and non-absorbent characters. It is also largely employed in life-saving appliances.

426. KAPOK IN THE PHILIPPINES. (*Philippine Agr. Rev.*, xix., **3**, 1926. Abstr. from *Trop. Agriculturist*, Ceylon, lxxiv., **1**, 1930, p. 26.) Deals with the cultivation, yield, uses, and by-products of the kapok tree.

427. KENDYR FLOSS: PROPERTIES. By N. L. Karawajew and P. N. Odinzow. (*Papier-Fabr.*, **28**, 1930; *Ver. Zellst. Ing.*, 133-136. Abstr. from *Summ. of Curr. Lit.*, x., **7**, 1930, p. 155.) Kendyr floss from the seeds of the plant has an average length of 20 mm. and a thickness varying from about 20μ at the base to 4μ at the tip. The cross-section is circular, and shows a central canal. The fibres are very brittle. The results of determinations of water content, ash, fat and wax, lignin, cellulose, pentosan, hexosan, and protein contents, and ether and alcohol extracts are compared with similar determinations of flax, hemp, cotton, straw, and other materials. In cellulose content the Kendyr plant resembles rye straw, but requires a greater amount of alkali for the preparation of technical cellulose. It is not a suitable raw material for the preparation of nitro products, but since its ash content is similar to that of wood, it may be possible to treat it by the sulphite process. If its use as a cellulose raw material proves unprofitable, the fibre may find application for insulating purposes.

[*Cf.* Abstract **561**, Vol. VI., p. 358.]

428. MILKWEED FLOSS AND FIBRE: UTILIZATION. By F. Gerhardt. (*Ind. Eng. Chem.*, **22**, 1930, 160-163. Abstr. from *Summ. of Curr. Lit.*, x., **5**, 1930, p. 87.) Certain physical and chemical properties of the floss indicate its similarity to kapok. Commercial application indicates that where fibre brittleness is not the determining factor, milkweed floss may be used, especially in life-saving, insulating, and playground equipment. Approximately 10 per cent. of the dry weight of the stem is composed of bast fibres, which are stronger than those of flax, but not so strong as hemp. These bast fibres are soft, pliable, and almost white, and resemble flax very closely in appearance. The stem tissue contains 36·5 per cent. alpha-cellulose and compares favourably with many soft woods in this respect, while its hydration capacity, fibre length, and strength are favourable for the production of paper pulp of good quality.

PUBLICATIONS RECEIVED

We have to acknowledge the receipt of the following publications for the Library.

From Rothamsted Experimental Station.

CROWTHER, E. M.: *A Manometric Apparatus for the Direct Determination of Summation Percentage Curves in Mechanical Analysis.*

Nomographs for Use in Mechanical Analysis Calculations.

Some Physical Properties of Heavy Alkaline Soils under Irrigation (in the Sudan Gezira).

HAINES, W. B.: *Studies in the Physical Properties of Soil. V. The Hysteresis Effect in Capillary Properties and the Modes of Moisture Distribution associated therewith.*

HAINES, W. B., AND KEEN, B. A.: *A New Dynamometer, suitable for all Types of Horse and Power Drawn Implements.*

Studies in Soil Cultivation. IV. A New Form of Traction Dynamometer.

KEEN, B. A.: *The American Agricultural Research and Advisory System.*

The Limited Rôle of Capillarity in Supplying Water to Plant Roots.

Some Comments on the Hydrometer Method for Studying Soils.

The Value of the Dynamometer in Cultivation Experiments and in Soil Physics Research.

KEEN, B. A., AND SCOTT BLAIR, G. W.: *Plastometric Studies of Soil and Clay Pastes.*

SCHOFIELD, R. K., AND SCOTT BLAIR, G. W.: *The Influence of the Proximity of a Solid Wall on the Consistency of Viscous and Plastic Materials.*

SCOTT BLAIR, G. W., AND CROWTHER, E. M.: *The Flow of Clay Pastes through Narrow Tubes.*

SCOTT BLAIR, G. W.: *Ueber die Geschwindigkeitsfunktion der Viskosität disperser Systeme.*

The Revised Official British Method for Mechanical Analysis. By a Sub-Committee of the Agricultural Education Association.

PERSONAL NOTES

We much regret to announce the death of Mr. J. W. Ogden, which occurred at his home at Heywood, Lancashire, on March 23. Mr. Ogden was the president of the Amalgamated Weavers' Association, and represented that body on the Council of the Corporation.

The Corporation have accepted with much regret the resignation of Dr. E. J. Maskell, Assistant Physiologist at the Cotton Research Station, Trinidad, who has been compelled for family reasons to resign his appointment and return to live in England.

We also regret to record the death, on June 10th, in London, of Sir Frederick Eckstein, whose pioneer work in connection with cotton-growing in the Sudan is so well known.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Ceylon	Mr. C. D. V. Georgi.
,,	Mr. A. W. R. Joachim.
,,	Mr. L. Lord.
,,	Mr. J. J. Nock.
Fiji	Mr. J. G. C. Campbell.
,,	Mr. H. W. Simmonds.
Gold Coast	Mr. J. D. Broatch.
,, ,,	Mr. G. Cowan.
,, ,,	Mr. W. R. Hudson.
,, ,,	Mr. C. L. Skidmore.
India (Bombay)	Dr. W. Burns.
,, (Central Provinces)	Mr. F. Plymen.
,, (Punjab)	Professor W. Roberts.
,, ,,	Mr. T. Trought.
Kenya Colony	Capt. G. F. L. Burton.
,, ,,	Capt. J. McDonald.
Nigeria	Mr. K. M. Davies.
,,	Mr. F. D. Golding.
,,	Mr. T. Laycock.
,,	Mr. E. W. Leach.
,,	Mr. C. B. Taylor.
,,	Mr. G. N. K. Turnbull.
,,	Mr. V. J. Voelcker.
Northern Rhodesia	Mr. U. J. Moffat.
Sierra Leone	Mr. J. W. D. Fisher.
Tanganyika	Mr. E. Harrison.

Tanganyika	Mr. C. Harvey.
,, ...	Mr. H. Musk.
,, ...	Mr. W. Nowell.
,, ...	Mr. J. F. C. O'Brien.
,, ...	Mr. A. S. Richardson.
,, ...	Mr. A. H. Ritchie.
,, ...	Mr. A. J. Wakefield.
Trinidad	Professor Cheesman.
,, ...	Mr. R. O. Williams.
Uganda	Mr. G. F. Clay.
,, ...	Mr. G. S. Davies.
,, ...	Mr. G. L. R. Hancock.
,, ...	Dr. W. S. Martin.
,, ...	Mr. E. A. Ruck.
,, ...	Mr. G. H. Thomas.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving in this country:

Nigeria	Mr. H. Hutchinson.
Nyasaland	Mr. W. L. Miller.
South Africa	Mr. P. A. Bowmaker.
,, ,, ...	Mr. O. V. S. Heath.
Sudan	Mr. M. A. Bailey.
Trinidad	Mr. J. B. Hutchinson.

Printed in Great Britain by Billing and Sons Ltd., Guildford and Esher

THE EMPIRE COTTON GROWING REVIEW

VOL. VII. OCTOBER, 1930. NO. 4

THE CONFERENCE OF COTTON WORKERS

A FEW weeks ago, on August 27 and 28, a Conference of Workers on Problems connected with Cotton Growing, organized by the Empire Cotton Growing Corporation, was held at the Shirley Institute, Didsbury (Manchester), by kind permission of the Council of the British Cotton Industry Research Association. It was attended by over forty delegates, including members of the Corporation's own staff and of that of the Shirley Institute, as well as members of the Colonial Agricultural Services, and others. Those present had had experience of cotton growing in one or more of the following countries: India, the Union of South Africa, Southern Rhodesia, Sudan, Uganda, Tanganyika, Nyasaland, Nigeria, the West Indies, Ceylon, Egypt, and Brazil. Its beneficial effects must be judged by results which are still in the future, but so far as it was possible to tell by observation of what occurred, the Conference would seem to have been distinctly successful, and one may reasonably hope that those future results will be better by virtue of the interchange of ideas which went on, and of the opportunity afforded of establishing personal links between workers on common problems.

Leaving without consideration other than a mere imperfect acknowledgment, the tact displayed by those responsible, the success of the meeting owed much to the co-operation of the British Cotton Industry Research Association with the Empire Cotton Growing Corporation, resulting incidentally in the use of the Association's rooms for the discussions, and the opportunities of visiting their splendid laboratories, where testing of raw and manufactured cottons was going on. The chief feature in the organization that conduced to smooth working, and that struck us as well worthy of imitation at other congresses, was the publication by the Corporation, some weeks in advance, of good and full abstracts of the papers. One could thus attend the meeting knowing beforehand in some detail what was to be the subject of discussion in each case. The result, as compared with other congresses that we have attended, was that

discussion, rather than paper-reading, was the marked feature, and ample time was available to hear the views of those who had attended the Congress from the " ends of the earth." And as the attendance, with the exception of the writer and perhaps one or two more, was a body of specialists, this discussion was of a distinctly helpful kind.

The first subject to come up was " Immaturity " of the hair in the ripe boll—a description of abnormal behaviour in growth which is not perhaps quite the best, but which is well enough understood.

Neppiness.—Four papers, by Miss Clegg, Messrs. Peirce, Underwood, and Bailey, were concerned with the problems of cotton quality, or rather inequality, and more especially with neppiness, a fault which is annually the source of much loss, owing to the unevenness and imperfections that it causes in the various processes of manufacture, up to and including dyeing. An old spinner quoted by Miss Clegg calls it the " curse of Lancashire," and while at present Lancashire might perhaps be glad if this were her greatest trouble, there can be no doubt that it is one of very great importance.

Unfortunately there seems no way of avoiding neps in the yarn if they are present in the raw cotton (at least beyond a comparatively small percentage), and so it is chiefly up to the grower, the botanist, and the breeder to devise means for their elimination, or at any rate for their reduction in frequency. Neppy yarns are strong enough, in fact often the strongest, but their appearance is against them. Neppiness appears to be primarily due to what is—not very accurately—termed immaturity of the hair, the meaning of the phrase being that the hair has not properly thickened, and frequently rolls up when dry into a tangle which goes by the name of a nep.

There are a good many references in this journal to immaturity and neppiness. We may quote, without pretending to be exhaustive, Abstracts **158** (p. 78) and **529** (p. 337) in Vol. II.; **605** (p. 355) in Vol. V.; **526** (p. 353) in Vol. VI.; **123** (p. 77) and **468** (p. 318) in the current volume, while there are articles dealing with the subject in Vol. IV., pp. 319 and 327, and especially in Vol. V., p. 97.

The general impression that one gathers from the papers read, and from the points brought out in the discussion, is that neppiness, while always present to a greater or less extent (at any rate in the longer-stapled cottons), is distinctly increased by any conditions that may be looked upon as unfavourable to growth or to ripening. Among causes pointed out in the above abstracts, etc., and in the discussion, may be mentioned shortage of irrigation water, lack of proper rainfall, drought, gathering before the bolls open, gathering at the end of or at the beginning of the season, or after the bolls have been caught by

frost, and ginning while the cotton is still "green" or moist. A fair amount of detail about the question was given in Mr. Bailey's paper. The most frequent cause, as perhaps one might expect, seems to be deficiency in the supply of water; "the more droughty the conditions, the greater the amount of nep found in the finished yarn."

Coming now to the specific matter of neppiness in Empire cottons, there seems little doubt that *on the whole* it is more common than in American cottons grown in the United States or than in Egyptian cottons grown in Egypt. If, as the opinions above mentioned seem to indicate, neppiness is increased by unfavourable conditions, this result is one at which, perhaps, one ought not altogether to be surprised. To take some specific cases, the climatic strain on cotton in the Sudan seems to be undoubtedly greater than in Egypt, and in some of the quoted cases had been rendered worse by actual shortage of water. Cotton in West Africa, which is described as very liable to neppiness, has to undergo a severe strain when a wet season is rapidly succeeded by a very dry "harmattan" period. Or again, the climate of Nigeria perhaps causes greater climatic strains than does that of Uganda. And so on. There is little in the known facts of the neppiness in Empire cottons that seems inconsistent with the idea that it has, in them, been considerably increased by climatic or other strains which have been greater than in the original homes of these cottons, or of their immediate ancestors.

From what has been said so far, it may be inferred that neppiness is a character which is probably hereditary, but which may be very much increased, even if (possibly) it cannot actually be originated, by any seriously unfavourable conditions. What, then, is to be done about it?

So far no real remedy for neppiness has been discovered, nor is such a discovery likely to be made until we thoroughly understand the causes to which it is due, and how far they are environmental and how far hereditary.

There seems little doubt that both these factors come into play. Dr. Harland (*E.C.G.R.*, IV., 1927, p. 327) has shown that heredity is certainly one factor, and this indicates one direction in which it is possible that amelioration may be effected. Certain Mendelian factors cause the actual death of some of the seeds, and the hairs on dead seeds are particularly liable to be the cause of neps.

Unfortunately the production, and the non-production, of nep-forming hairs do not form a simple pair of characters from which straightforward Mendelian breeding can be practised. The problem is complicated by the fact that certain other factors (some lethal)

come in, and the likelihood of being able easily to eliminate the liability to neps is rendered correspondingly more improbable. At the same time, it appears to be quite within the range of possibility to breed a cotton which may perhaps have so small a percentage of neps that they would matter little in the final product.

The general evidence, however, goes to show that environmental causes have also a great deal to do with at any rate the increase of neppiness in any given strain of cotton, especially when it is moved to a new place. If the tendency to neppiness is present (as it evidently is in the ordinary Egyptian cottons for example), it may be made much more evident by environmental causes, and the real problem before us is not only to get rid of the tendency at its origin if possible, but at the same time to reduce as much as we can the increase of neppiness which is due simply to environmental causes.

It is clear that before we can work out our salvation we must have a thorough knowledge of the facts, and in this direction we still have very much to learn. For example, we do not yet know the exact distribution (nor even whether there is, or is not, any definite, or more or less definite distribution) of those hairs which are liable to cause neps. We do not know, and we ought to know, the exact details of the distribution upon the seed of hairs of different lengths (of course, under varying conditions) and different degrees of thickness. Halo observation seems to show longer hairs at the sharper end of the seed. Is this really so ? If there are any parts of the seed that tend to bear shorter or less thickened hairs than the rest, how are these situated with regard to the shape of the seed, the position of the embryo, the position of the rudimentary vascular bundles, and the like ? What proportion of neppiness is due to immature hairs on good seeds, and what to hairs on bad or dead seeds ? What relation does neppiness bear to weight of seed and its position in the boll ? Is there any relation to the position of the boll in time or space upon the plant ? To the number of flowers upon the plant, or the proportion ? Is there any relation to thickness of seed-coat, or to the relative weight of seed and coat ?

Is the proportion, or the amount, of neppiness diminished if the number of hairs per seed is lessened, and would it in that case be economic to breed for reduced hair number, or reduced hair weight ? Here, again, we do not know whether thinness of the wall is due to thinner layers, or to fewer layers, of thickening. And so on. There are many possible relationships of position, number, and other points that may affect the question, and until we have a thorough understanding of them, we are to some extent working in the dark.

The work of Professor McLean Thompson of Liverpool upon advancing sterility in stamens and carpels* indicates a line of work that may prove to have considerable bearing upon the work with which we are at present concerned. One feels inclined to imagine, looking at the dead hairs, that the available nourishment is only sufficient, in any given boll (or maybe branch), for x hairs, and if there happen to be present $x+y$, the food will be likely to go to the x and to leave the y alone, at any rate to a large extent. But for any work of this kind to be undertaken with any likelihood of success, it is clear that the countings for distribution, etc., already indicated above will first have to be made.

In answer to an enquiry, Professor McLean Thompson has very kindly sent me a reply, from which I extract the following: " It does seem worth while considering the aspect of correlation from the practical standpoint, and if the study can be complete, so as to cover not only the incidence of hairiness, variety (or species) by variety (or species) to maturity, and at the same time, stage by stage in development a chemical record of hair state is kept, it would be matter of surprise if valuable information were not forthcoming.

" The points you raise seem to me to be well worth enquiry, but if I could even suggest to you what originates hairy development in an ovary, and what inhibits it, or if one could know whether or not there is any comparison with andrœcial hairiness which is valid as to cause, there would be something definite to go on. I think comparisons between families are too often odious, but there is in my mind at the moment the question of varied hairiness in the Verbascums, Celsias, Veronicas. Here *roughly* the idea of correlation is tempting, for the early stages of failure of individual stamens are accompanied by increase in hairy display, reaching a maximum before the failure of the organ is *assured* from the stages of early differentiation. To put it in another way, in these genera hairiness marks the *height* of the ' struggle ' of the stamen to express itself in fertility, and is the sign of its certain failure, and at this stage the hairs are sturdy and strong-walled. But as the failure of the stamen is declared earlier in the ontogeny the hairs are at first sturdy and of perfect cellulose wall, but later are reduced, irregular, and of imperfectly matured wall. This I know for a fact, and I have often-wondered what is the connection between the protein deficiency which I find in these failing organs and hairiness. If it should turn out, for example, that for any reason there is excess of carbohydrate and

* "Studies in Advancing Sterility," *Publ. Hartley Bot. Labs.*, Liverpool, 1924 onward. *Cf.* also a paper by Youngman in this journal, VII., 1930, p. 7.

deficiency in protein (as a balance), at some stage prior to maturity, will this express itself in a tendency to a *variable* hairiness? I think this is a true point. If the protein content (or supply) is far below the normal carbohydrate supply at an early stage, many hairs may be laid down and extended, and yet there may be a later outlet in the flower for part of the carbohydrate, and 'perfecting' of the hair walls may never be completed. On the other hand, hairs may be laid down (as an excess product of respiratory expression) while there is a deficiency of protein, and later the latter may be made up and normal synthesis be attempted (and even accomplished) to the scarcity of hairs as a whole.

"What does hairiness 'mean,' and what does the absence of hairs 'mean,' in the *career* of any one organ? Practically your problem is bound up with these questions, and the degree and state of hairiness would seem to me to be open to understanding if they are answered.

"If I can help in any practical way, most gladly would I do so if it would be of any assistance to you."

The most evident factor in increasing the amount of neppiness would appear to be lack of water, and it is therefore possible that in certain countries where this lack is particularly liable to occur, simple breeding for drought-resistant qualities might be the most effective way of decreasing liability to nep.

Instead of breeding for fewer hairs—as has been suggested as a conceivable partial solution of the question—it is possible that a mere mechanical restriction of their numbers, by ordinary pruning of the bushes, might be useful. One prunes tomatoes to get the best results, and why not cotton? At present the only two results of pruning experiments that we have seen seem to be contradictory, and it is possible that this was due to pruning at different times (in relation to the time of flowering or other features in the life-history), for one would easily imagine that pruning at a given time might be just too late to determine the flow of sap in certain definite directions.

Another point that perhaps is not quite clear is the exact proportional thickness that a hair must reach before it ceases to be a source of danger in regard to neppiness (*cf.* Miss Clegg's paper, p. 4). Would it, for example, be advisable to breed for more hairs, but of less degree of thickening?

Again, one does not know if the proportion of neppiness falls off as the particular cotton concerned becomes more acclimatized to its situation. Does a little suitable manuring, or, perhaps even better, a little suitable watering at the exact right time, or the adoption of

"dry-farming" methods, reduce neppiness, and if so, would it be an economic proposition? (*Cf.* Bailey on Nep, p. 6.)

Neppiness is sometimes put down to the action of the gin, and particularly to the use of one kind of gin rather than another. There is little doubt that gin treatment makes into nep a certain amount of fibre that was not nep before treatment, but there seems little evidence that one gin is worse than the other, or at least the evidence is so slight that there is no good reason for changing.

Miss Clegg suggested trying the shorter staple American cottons instead of the longer, as they are not liable to neps. But, to begin with, do we know for certain that this is the case when they are grown in entirely new countries where the climatic strain may be greater? To grow them would be to sacrifice for a possibly small gain the present great and undoubted advantage that we possess in the fact that most Empire cottons show a longer staple, and command a higher price, than ordinary Americans, and, as was pointed out by Sir William Himbury, overhead charges are just as high on the shorter staple, and consequently higher in proportion. As usual in agricultural matters, the final question becomes one of finance, and one can hardly feel that the sacrifice would be worth while.

Uniformity of Character—i.e., of length, of diameter of hair, of thickness of wall, of colour, and so on, was dealt with in more detail in a paper by Mr. Underwood. It is fairly clear from a general consideration of the facts of biology, that complete uniformity is a counsel of perfection, but there seems to be little doubt that a considerable, or at least appreciable, improvement is possible in regard to uniformity, whether by direct breeding for hereditary character, or by making the conditions of life more uniform (again with financial considerations in view) by better cultivation, by better choice of sowing time when meteorological conditions are better understood, by suitable watering, by selection of similar bolls at the time of collecting the crop, or in other ways.

Greater proportion of immature hairs, considered above, has been said to be, in some degree at any rate, responsible for the great proportion of the shorter hairs found in a sample, for the immature hairs will be those most likely to break in the ginning. In fact, a saw-ginned sample shows a longer tail of short hairs than one that was hand-ginned from the same cotton. This again is a problem which requires to be worked out in considerable detail, with much counting of hairs at various stages of the process. The methods are obvious, but people shrink from the labour involved.

Colour of the raw cotton is another item with which there is

difficulty at times, and there are other qualities also which are liable to variation, very often from season to season.

To one who has been accustomed to deal with the cultivation of tea, a crop which upon a given estate is liable to show differences in quality at different times, and where there are recognizable differences from estate to estate, even with the same variety of tea, the general remedy which is in use with that crop—viz., *blending*—suggests itself for more extended use with Empire cottons.

So far as one can gather, while mixing of two or more kinds of cotton in fixed proportions is common enough, blending in the way in which it is done with tea or port, or other commodities where a given taste must always be kept to, is less in use. The spinner throws in a little of this or that brand to give colour or strength or what not, and this is probably all that is required with cottons that are produced in great quantity on comparatively small areas, as in the United States, and on areas where the variety has, so to speak, had time to settle down. But with many Empire cottons the range of variation is still very large, and one can quite imagine that definite blending might be of use. Of course, only those cottons can be blended in any given case which agree more or less closely in hair weight per unit length, etc., but the technical knowledge of the spinner and the skill in grading of the broker should prove of the very highest service, and just as the tea "taster" says on one occasion that you want so much of *a*, so much of *b*, and so much of *c*, etc., to make your standard tea, and on another occasion says that different proportions are required, so one might give the right quantities of *a*, *b*, *c*, etc., needed on each occasion to maintain the standards of colour, strength, etc., that may be required to spin a particular brand of yarn.

This is merely a suggestion put forward for consideration, for, of course, mixing is nothing new, and in this connection Mr. Roberts' remarks upon the mixing that is regularly practised by growers and sellers in India may be referred to (*E.C.G.R.*, VII., 1930, p. 277). [*Cf.* also Turner on Spinning Tests of Mixings of Indian and American Cottons, abstract **584** in this number. He shows that there is no difficulty if the lengths are not widely different, and the fibre weight per inch is much the same.]

Blending, of course, involves considerations of colour, strength, relative length of staple, and other qualities, and must therefore long remain a question mainly of high skill in judgment of these upon the raw cotton, rather than of definite scientific measurements of these qualities.

Finally, however, it must be pointed out that a good deal of blending will be done automatically as the areas under cotton increase.

New Place Effects.—These first points lead on naturally to the paper by Mr. Hutchinson upon New Place Effects in Cotton. The best example quoted was the superior lint given by Mesowhite in Iraq as compared with America, the home of the original variety, but new place effects were not very clearly defined or distinguished. The effects shown in a number of Empire cottons upon quality, length, and other characters, while in a sense new place effects,* seem rather, perhaps, to be attributable not to the mere change of locality, but to changes in the incidence of factors of climate and probably of soil. Sea Island cotton, when grown upon our Cotton Experiment Station in Ceylon, though it grew well enough, showed rather marked differences (especially in time) in length of fibre, and the same was the case with the same cotton grown on an experimental plantation that we inspected near to Rio de Janeiro. Probably a greater climatic strain was largely responsible for these differences, but the whole matter is well worth careful investigation, in view of the importance of the greater neppiness of several of the Empire cottons. Mr. Harrison (Kenya) said that a variety should never be thrown away in the first year. Others were inclined to think that parasitism, insect pests, and other factors were concerned.

Varieties Suitable to the Whole of a Country, and Seed Exchange.—The next point to come up was whether it was practicable to obtain a single variety of cotton suitable, for instance, to the whole of Uganda. The importance of this lies in the fact that if it were feasible the number of experiment stations and breeding specialists might perhaps be reduced. It is further possible that strains produced for one country might be available for another where conditions were somewhat similar, thus saving the latter, or both, some at least of the expense of breeding.

This seems a very wide question, and we have but a very few facts to go upon. Such as there are, however, are against the proposition, and the opinion of the Conference was also strongly against it. A great deal of interesting information would probably be derivable from a really detailed study of acclimatization in a number of different places, but the number of factors that affect it is very considerable, and there would probably be many surprising results. The moun-

* Mr. Underwood stated that cottons transferred from their original habitat always give irregular frequency diagrams; the irregularity seems to decrease as time goes on.

tain garden in Ceylon, at an elevation of 5,600 feet in latitude 7° N., has a mean temperature of about 60° F., which is nearly constant throughout the year. Rio de Janeiro, at sea level in latitude 23° S., has a higher mean temperature, with an annual range of about 10°. Its coldest month is thus about the same as in the Ceylon hills, yet "European" flowers do better in Rio, and set seed there, which they do badly in Ceylon. At the same time, one can grow in Rio most of the plants of the equatorial regions, which will not grow in the hill gardens of Ceylon except under glass. The soil is not very dissimilar in the two places, and both have a well-distributed rainfall, and are practically always green. Even between Rio and Calcutta, in the same latitude, the differences are very considerable.

There seems little to go upon at present if one is asked whether a plant x will suit a country y. One can only say that it may—it may be that it will only survive there, it may be that it will spread and become a troublesome weed. Nothing but actual trial will give any certain dictum at present. If the country concerned is willing to take the risk of waiting a long time before really suitable varieties turn up, it may save a little expense, but it hardly seems worth it.

One can never say offhand that a plant x will suit a country y. Often, as with many of the weeds that have spread so widely in Ceylon—*e.g.*, Lantana, Tithonia, and Mikania—a period of acclimatization seems to be needed before the plant, so to speak, seems to be thoroughly at home; in other cases this is not so. U 4 cotton seems to be succeeding in a great variety of countries and climates, while cinnamon has not yet found a really suitable home outside of Ceylon, though there seems no very obvious reason for this.

Whether one variety can be found that is really suitable for the whole of a given country—for example, for Uganda—must depend upon the local conditions within that country, and just as for exchange from one country to another, so for local use we require detailed local knowledge, and definite trial in one part of the country of any variety that has proved successful in another. Details of such an experiment concerning Uganda are given in the letter from Mr. Nye to the Senior Agricultural Officer at Serere, and one can only await with interest the results that may be published in 1933.

Mr. Wakefield in his paper brought up the question of the organization of seed exchange for such purposes, and his suggestions should be carefully studied.

Maintenance of Purity.—This subject was followed by a consideration of maintenance of purity of cotton strains under distribution to peasant farmers, introduced in a paper by Mr. Lewin,

who pointed out two essential requirements if the greatest possible purity is to be maintained: (1) The reduction to a minimum of the stages between the breeder and the farmer, and (2) complete renewal of seed at frequent intervals. These requirements involve rapid multiplication, and complete control of seed by the Department of Agriculture or other responsible body. He went on to describe in detail the system employed in Nigeria, the chief difference from the usual being that seed is supplied directly by the breeder to selected farmers (this avoids the risk of specially unfavourable conditions upon the ordinary seed farm), and from them, by way of special ginneries, to the ordinary cultivators.

The real difficulty arises when a second improved variety is introduced to take the place of the first, for it will be very hard to ensure that all the seed of the latter is collected or destroyed; how this is to be overcome, it is at present not easy to see.

Incidentally, in this connection, reference may be made to Abstracts **49** (p. 62), **229** (p. 157), and **516** (p. 365) of Vol. II.; **49** (p. 64), **132** (p. 73), **205** (p. 177), **247** (p. 185), and **414** (p. 391) of Vol. III.; **12** (p. 62), **188** (p. 174), and **214** (p. 181) of Vol. V.; **308** (p. 260) of Vol. VI.; and **299** (p. 227) and **446** (p. 313) of Vol. VII. Also to Articles by Balls in Vol. III., p. 331, and by others in II., p. 177; III., pp. 24, 82, 95, 154, 160, 317; IV., pp. 125, 224; V., pp. 3, 8; VI., p. 211; and VII., p. 91.

Correlation of Strength with Hair Properties.—A paper by Drs. Foster and Gregory followed, upon methods of correlating the strength of cotton yarn with the hair properties. If a satisfactory formula could be devised, which would enable one, from measurable characters of the raw cotton, to predict fairly closely the strength of the yarn that would be spun from it, it is clear that a great advance would have been made, and one which would cheapen considerably, as well as accelerate, the work of the breeder.

The difficulty lies largely in the fact that arbitrary methods have to be employed in so many cases—*e.g.*, arbitrary lengths chosen to make the strength measurements, and so on, while at the same time the strength of a given yarn is not uniform along its whole length, so that in determining it, one is really determining the strength of the weakest part, and how (relatively) weak a part may be depends upon many factors in spinning, drafting, etc. The strength of the weakest link, however, is often of importance. For the present it seems as if it would be necessary in general to depend upon spinning tests, a cumbrous, but fairly reliable, method of determining the value of a cotton.

Papers by Dr. Maskell upon *Field Experiments and the Analysis of Yield Variation*, and by Drs. Gregory and Crowther on the *Interrelation of Factors* in determining the growth of the cotton crop in the Sudan, followed. The first paper was brought up with the idea of co-ordinating and extending the information obtained by field experiments. Since Fisher has brought out his work upon the Analysis of Variance it has become much more possible and simple to carry out experiments that involve the simultaneous variation of more than one factor. The result of the adoption of these new methods will of course be the much more rapid accumulation of data, with correspondingly greater necessity of proper co-ordination. In fact, it was suggested at the Conference that the Corporation would be well advised to appoint a definite "Co-ordinator" for co-operative experiments all over the Empire. Unless this officer were also to work for some such body as the Colonial Office, which could employ him in connection with Departments of Agriculture, it would hardly seem as if there would be full time work available for him.*

The second paper above referred to was an excellent example of the results which may follow from the proper use of these complex experiments. It gave a combination of treatments with four variables (sowing date, spacing, water-duty, nitrogen supply), which numbered seventy-two, and each was carried out upon four distinct plots. Incidentally the authors find that Balls' conclusion that final yield depends upon the water supply is insufficient, and that nitrogen supply is the principal factor in the Sudan.

Dr. Maskell ended his paper with a list of observations that he suggested should always be carried out in connection with such experiments, but the general opinion of the Conference seemed to be that however desirable they might be, they would involve so much work that in most cases there would not be sufficient funds to meet the cost, even if there were sufficient trained observers to carry them on.

Blackarm Disease was the next subject to come up. It has already been the subject of much reference in our columns, and we may give the chief entries here: Vol. II., 33, 203, 362; III., 299, 300, 406, 408, 399; IV., 73, 108, 265, 267, 268, 269, 326, 379, 386; V., 11, 29, 70, 79, 181, 185, 192, 193; VI., 8, 12, 52, 69, 70, 86, 87, 124, 160, 180, 196, 243, 248, 281, 282, 305, 307, 370; VII., 30, 127, 159, 185; also Rep. Exp. Sta. 1927-28, p. 158. (All numbers refer to pages.) The disease is the cause of very serious losses of crop in a number of different countries, more especially in tropical Africa.

* *Cf. Nature*, vol. cxxv., p. 553, 1930.

A comparatively new departure has lately been made, in the study of this disease at Rothamsted under independently controlled conditions of soil temperature, air temperature, illumination, and air humidity, and in a paper read to the International Botanical Congress at Cambridge, Mr. Stoughton, who is in charge of the Rothamsted experiments, showed that seed carrying the organism on the outside produced infected seedlings at all temperatures up to the maximum for healthy germination (35° C.), whilst in his paper at Didsbury he pointed out that infection appears to be chiefly from external infection of the dry seed, though some may arise from persistence in infected plant remains. He went on to consider how spread of the disease took place in the field. Massey (*E.C.G.R.*, VI., 1929, p. 126) put forward a theory that a systemic infection of the plant is possible without external sign of the disease, and that this infection becomes localized, producing the typical disease, in suitable climatic conditions.

A greater probability attaches to spread by wind-blown rain, while insects, contact of twigs, etc., are also of some importance. Experiments are in progress at Rothamsted upon the influence of temperature and humidity upon infection. Much remains to be made out in reference to this disease.

Considerable discussion followed this paper, and among the points brought out were: that disease causes heavier losses than is always supposed (cereals, for example, grown free from all disease, gave yields to 100 per cent. greater); that in Uganda a bad attack began upon a sandy soil, which afterwards proved to have a pan; that Sea Island cotton, which is very resistant, should be specially investigated; that it is possible that external disinfection, though reducing the disease, may not be worth the cost; that cotton shows less disease when mixed with yams; that early infection may cause a total failure of yield, while later infection is not so serious; that it is conceivable that some of the other forms observed by Mr. Stoughton may tide over unfavourable periods; that it is apparently not a debility disease; that sulphuric acid is a dangerous and troublesome disinfectant, and that something safer, and as certain, is desirable; that the effects of temperature changes between day and night should be investigated; and other things. Mr. Stoughton insisted, in answer to criticism, that it was a good thing to work out the effects of all conditions and factors, even though the Rothamsted plants were obviously not growing in fully natural conditions.

Halo-Lengths.—Mr. Bailey (Sudan) read a paper dealing with the desirability of exchanging details of methods employed in

measuring halo-lengths at different places. The advantage of standardizing such things is evident, but it is very difficult to bring into general operation. Mr. Bailey gave details of the method employed in the Sudan, and proposed that similar details should be collected from as many other places as possible. Sir James Currie, on behalf of the Corporation, promised that this should be done through the medium of this journal, and we may take the opportunity of calling the attention of all concerned.

Erosion.—Dr. Joseph of Rothamsted introduced a discussion upon erosion, and called attention to a paper by Dr. Middleton, published by the U.S. Bureau of Soils, as being particularly useful in this connection. We have already brought up the subject, which always seemed to us of unusual importance in a badly eroded country like Ceylon, in an article in this journal, Vol. VI., p. 295, and it was of much interest to hear Dr. Small describe what has lately been done in that island. A Commission has been dealing with the matter, and its report is expected by the end of the year, and should be in the hands of all who are employed in agricultural matters in the tropics.

It was pointed out by Mr. Lewin that while keeping a succession of crops going upon the same land was a valuable preventive in many places, cotton was rather troublesome as a member of this rotation, as it would not follow closely upon green manuring, and did not properly hold the soil when it could at length be put in. The natives get over this by planting it in a standing yam crop, and this method has much to recommend it (*cf.* above, p. 273, fourteen lines from foot).

Chimæras.—This was succeeded by a paper by Professor Weiss, suggesting that possibly in some cases graft-hybrids, or rather chimæras, might be possible in connection with cotton, though it would hardly seem likely that they could ever be an economic success. There is also the possibility of ordinary grafting upon a resistant stock like Indian cotton, which must not altogether be ruled out.

Mr. Hutchinson said that cotton was an obstinate plant to handle in this manner, and that he never got good callus nor adventitious buds.

Picking-Machines.—Finally, the question of picking-machines came up for consideration, the idea suggested in the introductory remarks being that their use might decrease the cost of cotton used as an intermediate crop in sisal hemp. The general feeling of the meeting, as indicated in the remarks of one or two who had seen them at work, was that no optimistic view could be expressed about them at present.

"CROP FAILURES" AND MIXING OF PUNJAB AMERICAN

BY

W. ROBERTS,

Managing Director B.C.G.A. (Punjab) Ltd.

THE Punjab cotton crop has periodically suffered from disasters. In 1905, when only a few hundred acres of American were grown and the crop consisted of the indigenous " Deshi " types (*G. indicum*, *G. neglectum*, and *G. sanguineum*), nearly the whole crop was destroyed by boll-worm. Again, in 1911, this pest did very serious damage, but in this year, when the American area had reached a few thousand acres, it was noticed that American cotton was very lightly affected. This was undoubtedly a big factor in increasing the popularity of this cotton before the Agricultural Department had succeeded in introducing a selected type.*

The next minor disaster was in 1913-14, when 3F was put out to Zemindars on an area of 400 acres.† Nearly the whole crop of 3F was severely damaged by jassids, but there is some doubt now as to whether " White Fly " was not partly, at least, responsible for this disaster. In 1919, when the American cotton area was about 300,000 acres and the total canal-irrigated deshi about 1,000,000, the crop suffered severely—but more particularly the American type —through shedding and immature opening of bolls. Extensive investigations were made at the time into the cause of the disaster, and in his report Mr. Milne attributed the damage to shortage of water at maturing time. Dry west winds in September and October were thought to have caused extensive demands on the transpiration mechanism of the plant, and further, water which should have been given to cotton in October was largely utilized for wheat sowing. This latter is an annual occurrence, and the statistics given in the report do not really substantiate the claim that the humidity was excessively low as compared with other years, when no shedding had taken place. It is a fact, however, that plants which were partly sheltered by wind-breaks suffered considerably less than others, and in them the bolls opened and matured more naturally. A

* See also *Agric. Journal of India*, vol. x., pp. 343-348.; vol. xi., pp. 238-242.

† *Ibid.*, vol. xxiv., pp. 77-81, for full account of " White Fly " epidemic.

similar epidemic on a less severe scale in 1921 was explained in like manner. The next big failure occurred in 1926-27, and to a less extent in 1927-28 and 1928-29. The extent of the damage may be gauged from the fact that the yields on the B.C.G.A. Farm for the three years 1922-23 to 1925-26 averaged 15·1 mds., whereas for 1926-27 to 1928-29 they averaged 7·5 mds.

New light was thrown on the whole problem by the B.C.G.A. in 1927 through Mr. Roger Thomas, who had joined the staff at Khanewal during the winter of 1926. He predicted, in the early summer months of 1927—after noticing the complete failure of the tomato crop at the Bungalow owing to white fly, and the large numbers of this pest also on cotton—that this might have been the main cause of previous failures, and if so the 1927-28 crop would be poor. This was fully confirmed, the average yield on the B.C.G.A. Farm in 1926-27 having been 8·75 mds., whereas in 1927-28 it fell further to 6·3 mds. on an area of approximately 2,500 acres of cotton. The B.C.G.A. took the matter up courageously in 1927, and in the face of strong opposition succeeded in inducing Government to concentrate on Mr. Thomas's theory. It is very gratifying to be able to testify to the assistance received both from the Punjab Government and the Indian Central Cotton Committee in this work. (See Article by the writer in *Agricultural Journal* for March, 1929, vol. xxiv., pp. 77-81, for a full account.) Variety 4F suffered more than 289F, which was comparatively immune. The relation of yields of 289F and 4F during the three bad years at Khanewal are given below:

	289F.	*4F.*
1926–27	5·2 maunds.	5·8 maunds.
1927–28	5·1 ,,	3·3 ,,
1928–29	8·1 ,,	1·7 ,,

A small area only of 4F was grown (600 acres) in 1928-29, and none at all in 1929-30 on the B.C.G.A. Farm. It is only necessary to add that the various lines of attack being adopted against "White Fly" are continuing to give very encouraging results.

The actual yields of cotton in 1929-30 at Khanewal were:

Deshi (*Mollisoni*)	10·25 maunds.
289F	10·0 ,,

and as the latter fetched about Rs. 2 (3s.) more per maund (82⅔ lbs.) of seed cotton, the profit per acre was higher than from Deshi. In eight other farms controlled by the Association the actual yield of 289F was considerably higher than all other types.

It is of interest to note that at an official conference held by the Minister of Agriculture at Simla in August, 1929, it was decided not

to adopt 289F officially, but to continue with 4F, though at that time the Association had an area of 5,000 acres under 289F, and will this year grow 10,000 acres. Further, considerable quantities of seed have been sold in 1930 to the Agricultural Department, and the total area under 289F will not be far short of fifteen or even twenty thousand acres.

Some of the varieties being multiplied at Khanewal and elsewhere for Mr. Trought, the Cotton Research Botanist, are considered by the writer to be even better than 289F. In his opinion also the main hope of the future lies in the rapid replacement of 4F by a more suitable type.

Mixing.—American cotton has extended partly at the expense of Deshi cottons in the Western Punjab, and nearly every farmer grows both kinds. This practice will almost certainly continue. The farmer grows and markets both types practically pure, and understands the importance of doing so. Pure seed sufficient to sow 189,000 acres was sold by the Association alone in 1928-29. The presence of two types of different staple and value has, however, been an irresistible temptation to the small trader, the factory owner, and even exporters and mill agents, and mixing has, therefore, been resorted to on an increasing scale from the commencement of the introduction of the American type.* The mixing is done openly, and cotton is sold on a basis of 10 per cent. up to 50 per cent. or more admixture of Deshi. The proportion can be easily checked by counting the seed of each type in a sample of seed coming through the gins. If a buyer contracts for 20 per cent. and the seller tries to give him more, he is liable to have the bargain cancelled, and will be penalized in future contracts. Generally speaking, therefore, the mixing is honest, straightforward, and above-board. A seller consigning cotton to Bombay or Karachi for sale mixes at his own risk, and no buyer will take the cotton as pure unless he has confidence in the honesty of the seller. When the crop has partly failed, as, for example, in 1926-7 to 1928-9, the cotton bolls open badly and the staple is weak, but it has become the habit to put all the blame on mixing. The crop regained its reputation in 1929-30, though probably 50 per cent. was mixed more than in previous years. Buyers who are willing to pay a fair price can always obtain pure American. The writer estimates that in 1929-30 out of a crop of about 400,000 bales, about 10 per cent. was marketed pure or under 5 per cent. mixture; 60 per cent. with about 20 per cent. admixture, and 30 per cent. with mixtures up to 50 per cent.

* See *Agric. Journal*, vol. xi., p. 347.

Is mixing an evil? The answer to this is undoubtedly in the affirmative. Users have become unaccustomed to the appearance and look of pure American, and plenty of buyers at Bombay and elsewhere distrust the look of the pure sample. The trade has become used to the mixture.

The evil of mixing was prevalent in 1915 and 1916 (see articles referred to above in *Agricultural Journal of India* for 1915 and 1916). The general tendency of mixing has been to lower the premium on American, and thus reduce the price which the Zemindar receives. Anyone who engaged in business in American cotton in the Punjab and strictly refused to deal with or sell mixed cotton would, however, soon go to the wall, as the selling of mixed cotton is definitely more profitable than handling the pure type.

All bales turned out by the B.C.G.A. Factories which are mixed have the letters "XD" prominently stamped on the hessian covering the bales as they leave the press. As the Association Factories handled altogether only 40,000 bales, of which about 15,000 were pure, this action is not likely to have very appreciable influence, but it has been and will be strictly adhered to. It was as a result of discussions with Mr. Ellis Jones, lately Vice-President of the Indian Central Cotton Committee, that this step was put into operation two years ago.

While the writer regards mixing as an evil, it is a minor one compared with the crop failures which have periodically occurred, and it will be more profitable to all concerned if attention is concentrated on overcoming these crop failures, leaving the question of mixing gradually to attain equilibrium.

CORRECTION.

In the fifth line of the previous article, "Introduction of American Cotton in the Punjab," in this volume, p. 181, *for* 1928 *read* 1918.

THE EXPERIMENT IN CO-OPERATIVE FARMING AT DAUDAWA, NORTHERN NIGERIA

BY

GILBERT BROWNE,

Manager of Seed Farm, Daudawa, Nigeria.

In 1927 it was decided to commence a co-operative farming scheme on part of the Corporation's leasehold land at Daudawa, in the Northern Provinces of Nigeria, with the twofold object in view of (*a*) assisting certain industrious and thrifty native farmers to farm in a proper manner under European supervision, and (*b*) increasing interest in cotton-growing. They were to sow the same seed as that sown during the corresponding period on the Corporation's seed farm close by, and the resulting seed-cotton was to be purchased by the Corporation at the highest obtaining local price, thus swelling the amount of seed available to the Agricultural Department.

After reading this article it may be wondered in what sense the scheme is "co-operative." To understand this fully it should be explained that the object of the Corporation in making the large seed farm at Daudawa is the mass multiplication of selected strains of cotton seed for the Agricultural Department. The seed from the co-operative farms, therefore, makes a welcome contribution towards this end, and apart from the initial cost, which it must be admitted is fairly heavy, the cost of producing this seed is practically nothing. The seed-cotton is ginned along with that of the larger seed farm and the lint is sent to England to be sold in the same way.

The site chosen for the co-operative farms is on a ridge facing south and covers the site of what must have been a fairly large town. On enquiry it was found that the name of this town was Kotanga, and that the inhabitants were wiped out in a single night during the Fulani invasion scores of years ago. Unfortunately some laterite outcrops spoil some of the farms, but in these cases, as some of the outcrops are large, further bush has been cleared and laid to the arable portion.

In the spring of 1927 a start was made by laying out four farms on the same base-line as the larger farm. The whole of this part of Nigeria is covered by bush, which is larger than that described

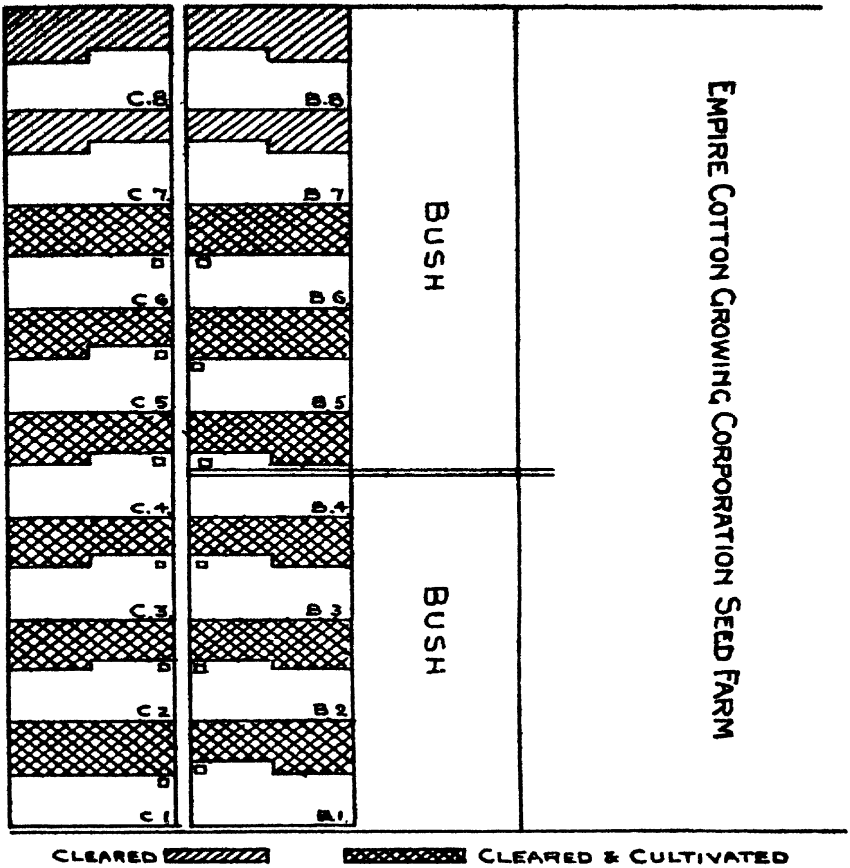
as "orchard"; every bit of land must therefore be cleared before any crops can be planted. Each farm measures 220 by 220 yards, thus making an area of 10 acres. This plot is divided into two equal parts, one of which remains in uncleared bush for possible extension or for grazing in the event of cattle being purchased; the other half is all cleared with the exception of ½ acre, which is left as a homestead site. The wood from the area cleared (4½ acres) is carried to the side for future use as firewood when the prospective farmer has moved in. Clearing is done in exactly the same way as on the Corporation's farm —*i.e.*, all the lateral roots are cut at a distance of 3 to 4 feet from the trunk of the tree, the tap root is also cut, and the whole is then pulled or pushed over. This method has been found to be not only quicker, but cheaper than other more complicated ways, although in the case of co-operative farms, where it is desired to leave all wood for use, the carrying of it to the edge of the farm naturally increases clearing costs a little.

The ground is hoed over later in the season when time and labour can be spared from the seed farm. It nearly always happens, therefore, that this cultivation has to be done in the dry season, and if an average of 5, or at the most 6, inches depth of hoeing can be maintained, it is considered to be pretty well hoed. Later it is ridged up into straight even rows 3 feet apart, and in due course planted in crops. It is usual in the first year to plant 2½ acres out of the 4½ cleared in bulrush millet, which is later interplanted with guinea-corn. The millet is planted with the second or third rains and the guinea-corn as soon afterwards as rains permit, possibly in two or three weeks. The remaining 2 acres are left for cotton, which is usually planted in June.

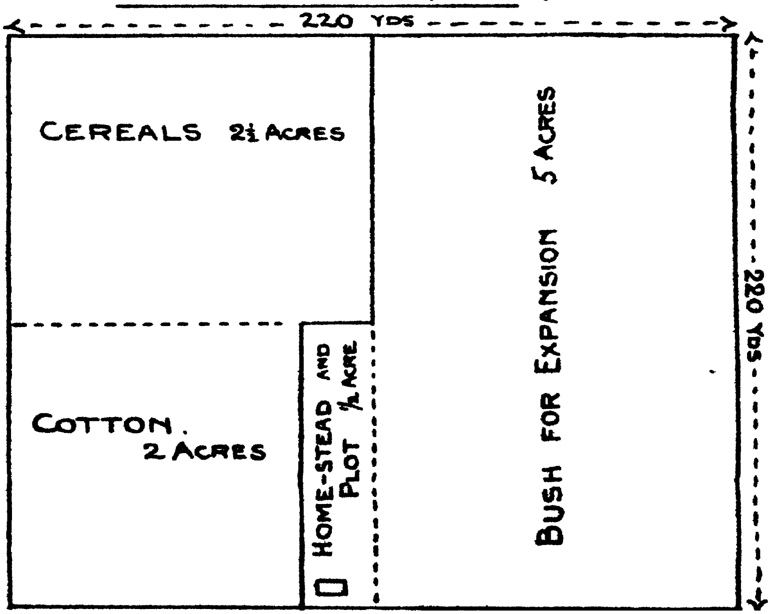
At the beginning of the following dry season a start was made on building the houses. This has been rather a difficult problem, as it is still a moot point as to whether a native really likes a little light in his house or not. After three years' experience of building houses for natives with adequate openings for the admission of light and air, and later going round and finding them stuffed up with rags, grass, etc., one is inclined to think that he is not. On the other hand, glazed windows which would admit light without the attendant discomforts of rain and wind, have not been tried, so that it is hardly fair to judge as yet.

The first three houses to be built were on the South African "rondeval" principle, with the difference that, in our case, just two ordinary round-type houses were joined together by a sort of passage. The difficulty with these was primarily the cost, and secondly the

PLAN OF CO-OPERATIVE FARM SITE.



PLAN OF A FARM WHEN HANDED OVER TO THE CO-OPERATOR.



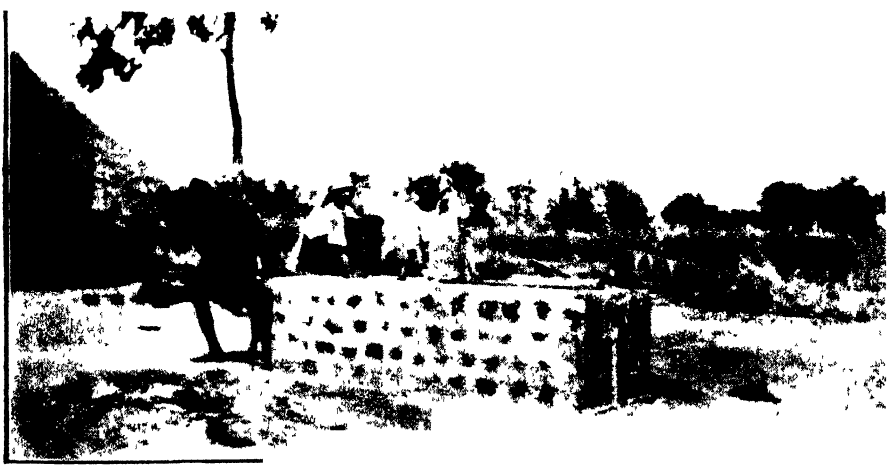
fact that the roof was difficult for the farmer to repair or reconstruct later, should the necessity arise; and in this country of rapid desiccation this amounts to a certainty. In addition, this type of roof has since proved to be too weak, and is at the moment sagging ominously in all three houses. Probably, had the houses been constructed with the correct type of roof, the latter difficulty might not have arisen, as the internal construction would have been stronger.

The best type of house so far has proved to be that most commonly in use here now. It comprises two rooms of 11 feet square, inside measurement, with a small entrance-room between them. This small central room can also be used as a store for the innumerable pots and pans dear to the native's heart, as well as for one or two bundles of guinea-corn. The front wall of the house is recessed a couple of feet on each side of the door, thus forming a small verandah. Outside measurements of the houses are 32 by 13 feet, while the height at the eaves is 5 feet 6 inches, and at the apex of the (span) roof, 11 feet 6 inches. The foundations are made of laterite (ironstone), and are built in trenches about 1 foot deep. When a level is reached above that of the surrounding earth, the work is afterwards carried out in dried mud balls in the ordinary way. The roof timbers are of a hard bush wood, preferably one capable of resisting the depredations of the white ant. After thatching, the walls are smoothed and given one or, better still, two coats of cotton seed tar. This has the effect of keeping rain and vermin out of the walls. As stated above, the roof is of the ordinary span type, and is made as simply as possible, so that the farmer can easily effect repairs himself, and even rethatch it when necessary. One of the first things he does, as a rule, is to put a compound round his house, and probably a sort of an annexe outside the door, where he and his wife (or wives) and family rest after their work is done.

As regards the selection of the farmer himself, observation is kept on likely men who are employed on the seed farm, and who have expressed a desire to have one of the next season's farms. The points looked for in choosing suitable men are (1) industry, (2) thrift, and (3) a wife. Certain time-expired ex-soldiers are very keen farmers, more than half the present farmers being ex-service men. Many men leave the Nigerian Regiment and come here on completion of their period of service, on the recommendation of the military authorities, but not many are considered steady enough or sufficiently capable farmers to be put into occupation of a farm. Those who are suitable make excellent farmers, having more initiative than the stay-at-home ordinary farmer. The men are in practice selected

A Last Year's Farm Note Grain on Raised Platform in Foreground.

A New Co-operative House, Just Occupied.



Co-operative Site Water Tank.

before the house is built, so that they may look after and harvest the millet and guinea-corn which were planted in the early rains.

Unfortunately the farms vary considerably in quality and freedom from rock, so that the prospective farmers are required to draw lots for farms. After this is done a short lecture is given explaining why the Corporation goes to the trouble of clearing a farm for them, building them a house, and settling them on a farm all ready made (whether they believe it or not is another matter). They are told that for one year they may borrow tools for cultivating or clearing from the Corporation's store, that they are expected to maintain the piece of road adjoining their farm, and to keep their house in good repair, and various little items of that nature. They are also told that the cotton seed which they sow will be supplied by the Corporation, and the resulting seed-cotton will be bought by the Corporation, otherwise the farm is theirs for so long as they want it, providing that it is farmed in a proper manner. It is impressed upon them that this is not a passing whim but a permanent settlement, and that they may stay there just as long as they wish. The fact that the Corporation have the large seed farm alongside gives them confidence. The farms are handed over officially when the houses are built and the cotton ready for picking, usually about the end of November. The period between the time when the men are selected, about July or August, and the official handing over, gives time for further observation of the man while he is working on his farm. It also gives him time to change his mind before he takes over, which is much better than later on when he has had the benefit of harvesting some crops. There are absolutely no conditions binding the man to stay any length of time, and he understands that he may go just when he cares to do so. With the exception of one vacancy caused through death, there have been no changes whatsoever in the farmers since the commencement.

The cost of the whole outlay is borne by the Corporation and works out at about £26 per farm. It may be of interest to note how this is made up. A rough account of costs is as follows:

	£
Laying out, clearing, carrying wood, and levelling $4\frac{1}{2}$ acres	10
Hoeing, ridging, and planting the crops of above	8
Cost of building and thatching the house	8
	£26

Of the first four farms cleared in 1927, one was considered to contain too much laterite outcrop and was dropped for the time

being. In 1928 three farms were cleared, cultivated, and occupied, and in 1929 five farms were similarly dealt with, and the one mentioned above as containing too much laterite had some land added to it, a house built, and is now in occupation. This makes twelve farms which are fully occupied up to the present. During the present dry season, a further four farms have been cleared ready for cultivation when time permits. It is intended that a few farms shall be added each year, so that the amount of cotton produced by the co-operative farmers may increase annually. To illustrate the important assistance the cotton thus produced gives to the Corporation's seed production schemes, it may be assumed that these sixteen farms will have a minimum of 2 acres each in cotton. This would mean well over 6,000 lbs. of seed in the coming season, which is no mean contribution towards the amount required by the Agricultural Department for redistribution to the native. Moreover, as already mentioned, with the exception of the initial cost of making the farms, the cost of production is practically nothing.

To give an idea of the yields obtained by the co-operating farmers from the first year's cotton crops, it may be stated that, taking as an example the farms B 1, B 2, and C 2 on the plan, which were those first made and put into occupation, the farmer in B 1 had a yield of 461 lbs. seed-cotton per acre, B 2 produced 425 lbs. per acre, and the man in C 2 had a yield of 412 lbs. per acre. These are undoubtedly excellent yields for Northern Nigeria, and with one exception have not been beaten—at Daudawa at any rate. The exception was the farmer in B 2, who last year actually had 480 lbs. of seed-cotton per acre. Up to the time of writing no such yields are likely to be recorded during the current year on the co-operative farms, though quite a number will, it is expected, exceed 350 lbs. per acre. The men are keen on surpassing each other, which is, of course, the right spirit.

To stimulate them further, a small prize was offered this year for the best cultivated farm, crops, and compound generally. The Director of Agriculture was good enough to judge the farms when he visited Daudawa, though this was unfortunately rather late in the season. The first prize went to the farmer in B 2, who is, incidentally, an ex-Company Sergeant Major, and not only very proud of his farm but a very good farmer. His yields of guinea-corn and millet are not only greater than those of his neighbours but also than those of all the surrounding farmers, who are frankly envious of his success with cereals. He has cleared almost to the full extent of the remaining 5 acres of bush, and has taken steps to procure cattle to start cattle

cultivation. Unfortunately the friend to whom he gave the required cash to go north and buy the cattle has not been heard of for some considerable time, which has been really rather a depressing start to his ambitious schemes for expansion.

Up to the present there has been no settled scheme of rotation or green manuring, as it was thought better to let the farmers get the notion themselves from the Corporation's Seed Farm where they are all employed during the day. Further attention will be paid to the subject of green manuring in the coming season, though it is not the policy of the Corporation to interfere, but rather to suggest and advise and let the example of the larger farm indicate to the co-operator the best practice to adopt to produce good crops. It can be truly said that no men have yet had to be pulled up for bad farming, and it really is extraordinary the amount of trouble they take to maintain a standard of cultivation almost, if not quite, equal to that practised on the main farm. Their farms being small, in the first year or two they have planted one half in cotton and the other half in cereals, and the following season they merely change over. The natives are not accustomed to the idea of permanently farming the same piece of land; they merely farm a bit of land to death and move on, hence the difficulty which may be expected in green manuring. As stated above, they have fortunately the example of the larger farm before their eyes daily, and it must be said that they realize that there is something in it, and it is hoped that a commencement may be made during the coming season in perhaps beans and cereals mixed. This suggests itself as being a suitable method of getting them started, for they cannot afford to have a quarter of their farm lying (what they would consider to be) idle. It is further to be hoped that the idea of cattle cultivation will also be acquired from the example of the larger farm, so that, say, two farmers may join in the ownership of a pair of cattle and a plough and so cultivate their two farms without having to hire outside labour, as many of them have to do at very busy times. The fertilizing value of cattle manure on small farms like these would be inestimable, and this point, at any rate, they realize. In illustration of the value of a European farm as an example to co-operative farmers, it is interesting to notice the way in which the ordinary native farmer in the locality has also improved his farming methods to conform with what he considers to be the best way to produce larger crops. The seed farm is frequently visited by the Emir of Katsina, and he is also very interested in the co-operative farmers. He always asks to be taken through the site to see for himself how they are getting on. Water has been taken to the farms, and each

four houses now share a small automatically filled tank (on the same principle as the cattle trough at home operated by a ball valve).

In summing up the degree of success that the experiment in co-operative farming has achieved at Daudawa, it may be said that (1) natives who have never farmed in a modern manner before are here carrying out their cultivation in the same way as would a European; (2) they are apparently contented with their lot and settle into a much superior domestic life than that to which they have been used; (3) they take a definite interest in their farms, such as one never sees the ordinary bush-farmer do, and (4) they farm well enough to have caused considerable hesitation on the part of the Director of Agriculture as to the allocation of the prize for the best farm.

It may be considered, then, that the experiment, if it is still to be regarded as such, is definitely a success. It gives one great pleasure to walk through the co-operative site in the evening and see the respective farmers tending their farms sensibly and methodically. It is also both pleasing and amusing to see the cloak of utter respectability which settles upon a native when he has been selected to be a co-operative farmer: perhaps they could pay the scheme no greater compliment.

In conclusion, the writer wishes to record the debt of gratitude he owes to Col. C. N. French, C.M.G., formerly Assistant Director of the Corporation, and to the Director of Agriculture, Mr. O. T. Faulkner, C.M.G., for their kindly interest and encouragement in this scheme from its inception.

Received April, 1930.

PATHS OF LONELINESS

BY

A. L. P. HIMBURY.

SOMEONE has written that "every man is the architect of his own fortune," and this is nowhere better illustrated than among the Zemindars of India, whose abhorrence of everything in the nature of an innovation is entirely in keeping with their extraordinary allegiance to the primitive methods of their ancestors. This attitude, allied to an hereditary slothfulness, has militated throughout against the most persistent propaganda of modern theorists, and it is precisely this conservatism which is responsible for the derelict farms which are noticeable all over India at the present time. Surely an amazing state of affairs in a land which is, in the very nature of things, so predominantly agricultural!

In the following article I have essayed to depict as accurately as possible some of the conditions under which a European Zemindar labours in the Punjab, and to this end I have drawn extensively from my own experience covering a period of roughly four years, during which time I have been actively engaged in opening up and developing an area of approximately two thousand acres.

There are, comparatively speaking, few Europeans engaged in cultivating their own lands in Northern India, and of these the majority are lessees, and may be counted on the fingers of the right hand. The reason for there being so few European proprietary planters is not, however, that there is a dearth of individuals suitably equipped in the matter of brains and a spirit of enterprise; nor does there appear to be a scarcity of persons who by instinct and natural habits are favourably disposed towards this sort of life. It seems to be very largely due to one of the following circumstances.

(*a*) There would appear to be a definite shortage of first-class land *outside* the new colonies, which have sprung into being contemporaneously with the expansion and extension of the canal systems. I say "outside" the colonies because it not infrequently happens that the land in these new colonies is not available to the ordinary bona-fide cultivator with limited means at his command. Auctions are periodically held by Government, with the result that the best areas pass to the highest bidder (often at a very inflated

figure), and the purchaser, who quite often does not belong to an agricultural class, merely seeks in his bargain an opportunity to aggrandize himself with the least possible delay (frequently at the expense of the land itself), or alternatively he puts such a figure upon his purchase as to place it beyond the means of the genuine cultivator.

(*b*) Tracts outside the colonies can often be leased by private treaty from the owners, but there is seldom an adequate irrigation arrangement, and without some such drawback as this the land would almost certainly *not* be in the market. It is admitted that the intending lessee has an opportunity to augment his irrigation facilities by means of "jhalars"* or tube-wells, but this entails a somewhat heavy additional expenditure, and it often happens that some considerable time after the wells have been sunk and tested, the water develops a saline flavour.

(*c*) A third consideration which sometimes precludes Europeans from participating in land ventures is shortage of the initial capital required to launch the enterprise in a proper manner, and to tide over the first few years, which are usually unremunerative and costly. Government has done much to relieve Indian agriculturists confronted with this sort of difficulty by the establishment of co-operative Credit Banks from which loans can be obtained at moderate rates of interest, but in the case of Europeans this remedy is seldom available because they are not generally owners of the land themselves, and English banks are prohibited, by the terms of their charters, from advancing loans against this form of security.

(*d*) A further circumstance, which affects some types of individuals more than others, is the fact that farming on new and undeveloped lands nearly always involves a period of considerable loneliness, since during the initial stages of the development of the estate there will almost certainly not be a bungalow on the land, and in any case the situation of the land itself may be such as to compel the lessee to take up his abode without his wife or family.

Before negotiating for the lease already referred to, I had the privilege of serving for twelve months as an Assistant at the British Cotton Growing Association's Farm at Khanewal, which is managed by Professor W. Roberts, B.Sc., late Principal of the Agricultural College at Lyallpur, and one of the most experienced authorities upon all matters agricultural in the Punjab at the present time.

Whilst motoring between Lyallpur and Lahore about the middle of the year 1926, I came across an extensive tract of uncultivated land situated around a village called Feroze, close to the banks of a dis-

* Jhalars—form of Persian-wheel for tanks or rivers.

tributary taking off from a branch of the Lower Chenab Canal. Observing from a most superficial glance that the soil seemed good and quite suitable for cotton (a sandy loam), it seemed strange that so attractive an area should have escaped the plough. Pausing to interrogate some villagers, it appeared that the land was about eighty squares in extent, but had never been cultivated because irrigation facilities were not available, the bulk of the area being "uncommanded" by the canal. The adjacent lands were under cultivation, however, and showed evidence of bearing heavy and healthy crops. As a matter of fact, it also transpired subsequently that a number of years ago a large portion of the tract had been declared by the owners as "banjar qadim," which, being interpreted, means "old land." This was to evade payment of land revenue in the days when it was assessed on the cropped area as against the present system, whereby the tax is levied upon the whole extent of the holding irrespective of whether the land is brought under cultivation or not. Apparently the corresponding adjustment had not been made in the new settlement records, and the landlords, for the reasons explained at the beginning of this article, remained content to graze their cattle on land which might have been turned to much better account.

It was also ascertained that a nine years' lease of the entire area might be available in the event of the lessee being able to arrange for an outlet on the distributary which would supply water to a pumping plant to be erected at the site.

As a matter of fact, the average Indian cultivator looks with considerable suspicion upon installations of this nature, involving a certain amount of expert labour and constant attention to repairs, etc., and prefers to utilize a pair of bullocks and a Persian-wheel where irrigation by flow is not found practicable. This is a very slow way of irrigating the fields, and the amount of irrigation under this method does not exceed one acre per day of twenty-four hours' duration, the land being irrigated to a depth of say 2 inches. This is much less than is usually given in canal lands, so it generally happens that lands irrigated by wells have to be watered more frequently than those under direct command by the canals.

A few days after the events narrated above, I visited the land and ran a preliminary line of levels through the area by way of arriving at a rough idea of the lines to be followed by the main water-courses, and subsequently the Irrigation Department were petitioned for an outlet on the Sharakhpur distributary at a certain point stipulated in the petition. The site I contemplated happened to be

above a certain bridge which spanned the canal close to this point, but when the outlet was built by the Canal Authorities, it was laid down *below* the bridge, presumably because the authorities felt some apprehension that the lessee would adopt a practice often indulged in by Indian Zemindars, which is to place large boards against the bridge in order to "head up" the flow, thus gaining a substantial increase of water passing into the outlet!

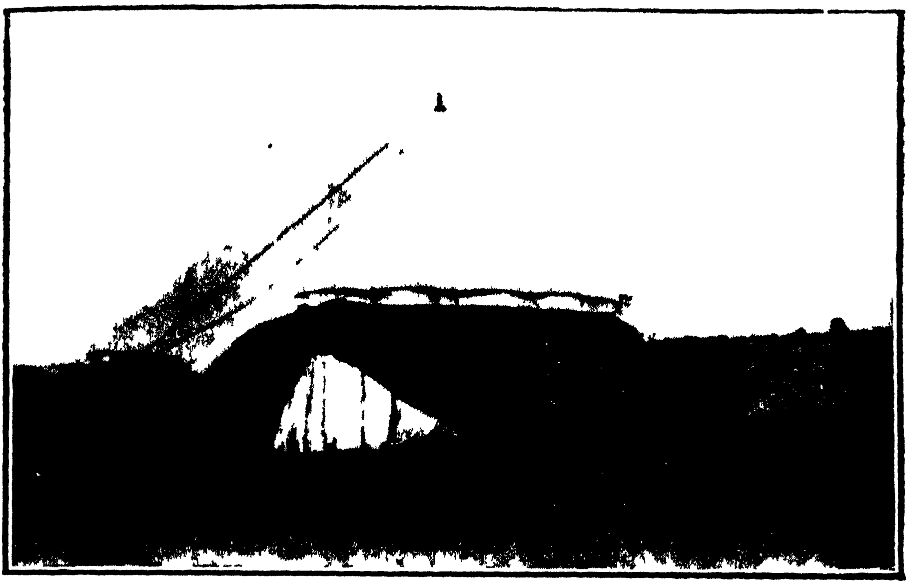
The outlet was ultimately sanctioned, and was of the Kennedy Standing Wave pattern designed to give a discharge of just over three cusecs,* the total area permissible under the canal regulations being only 780 acres out of 1,561 acres culturable. This is in accordance with canal rules, which only allow for 50 per cent. irrigation out of the area involved, and whilst in practice this actually works out at slightly more than this percentage, the additional irrigation available is almost negligible.

Our petition to the Canal Department having met with success, the next step was to approach the Civil Authorities with a request for sanction to build our main water-course along the square boundaries of some Government waste land which intervened for some distance between the outlet and the nearest boundary of the Feroze lands. This permission was readily granted by the Deputy-Commissioner, who issued orders to the patwari† to attend at the site without delay in order to mark out the lines to be followed by the water-course along the boundaries shown by the official map.

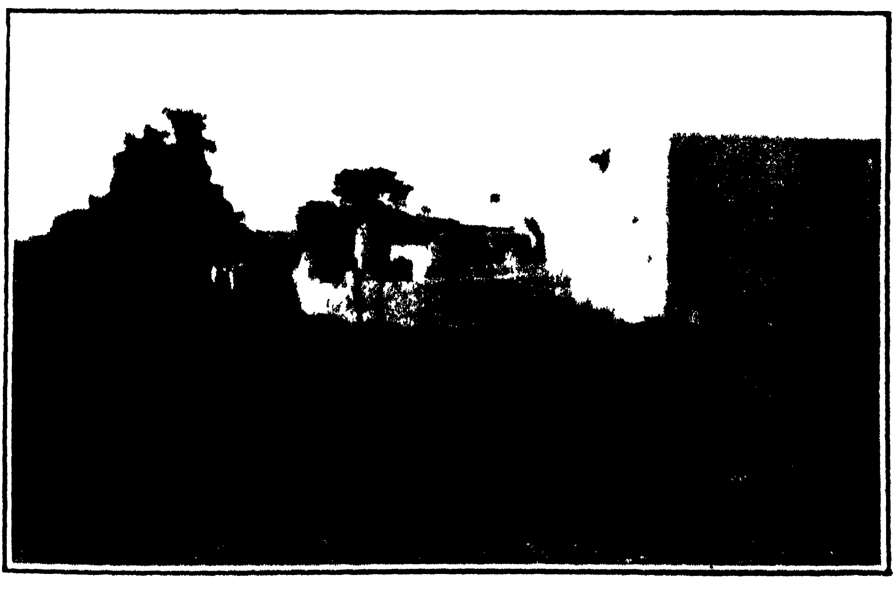
When this was done we had reached a stage which may be described as the real commencement of our labours, and as there were no buildings whatsoever on the land, I pitched a tent of the Swiss-Cottage pattern into which were transferred such "lares" and "penates" as were deemed necessary and expedient for the impending summer operations. Food provided an early problem, since the nearest market was about five miles away, and though a limited quantity of meat—euphemistically called "mutton"—was nearly always available in the village shops, I feared that the local butchers might be somewhat inept in separating the sheep from the goats, and decided in favour of "cave-man" fare, which combined the dual advantages of being cheap and very easily prepared! The following was my menu for all three meals during the first twelve months at Feroze, though upon certain festive occasions I "let myself go" and purchased some very diminutive eggs from the

* Cusec—technical irrigation term meaning a cubic foot of water per ond.

† Patwari—village Revenue or Irrigation subordinate.



My "House" for Twelve Months at Feroze



A Village on Feroze Lands

WEAVER AT WORK, FEROZE ESTATE

THE OUTLET (ON SHARAKHPUR DISTRIBUTARY) WHICH IRRIGATES THE FEROZE LANDS

village and drank coffee or cocoa instead of tea:—Tea and condensed milk; chupatties, dhal, potatoes, onions, and chillies.

The tent was very comfortable until about the middle of May, when it became so hot that I was obliged to live in a "sun hat," and upon occasions it became expedient to seek protection from the noontide sun by squatting underneath a wooden table (inside the tent).

For the first few weeks there was little time in which to write up daily accounts or attend to the hundred and one petty details necessary to enhance the comfort of the tent, because men and children from the neighbouring villages swarmed round the tent like flies round a honey-pot, inquisitive to catch a glimpse of the sahib whom I veritably believe many regarded as being a trifle mad. It is a little embarrassing sometimes to the most unsophisticated of us to be struggling with a particularly recalcitrant chupattie before the gaze of several dozen astonished faces, or to pause in the act of rubbing oneself down after a bath to discover a pair of eyes peering through a rent in the bathroom tent. However, these trials were small compared with the irritation caused sometimes by the following interrogatories which were hurled at one throughout the day, whenever one had the temerity to stretch one's neck outside the tent-flap:

(*a*) When was the water-course going to be completed?

(*b*) How much water would pass into the outlet?

(*c*) Why had the sahib installed an engine?

(*d*) Where was the sahib's wife and family?

(*e*) Why did the sahib live in a tent instead of in a mud hut in the village? (This latter was portentous, though it did not appear so at the time.)

(*f*) How many maunds of kapas* would the sahib get per acre?

(*g*) Why didn't the sahib tell the coolies on the water-course that they were encroaching on other people's lands?

(*h*) Why was the water-course being built in "filling" instead of in "digging"? etc.

The next problem which engaged our attention was the selection of tenants, and whilst there was no scarcity of applicants—many of whom came from considerable distances to seek engagement—we executed a very succinct agreement which embodied the usual stipulations regarding the number of cattle to be employed per square, and their various duties under the contract, etc.

Perhaps a word or two about the tenant system will not be out of

* Kapas=seed cotton.

place here, since most land (in the Punjab, at any rate) is worked by means of a valuable arrangement termed "batai." This resembles in some measure the old English feudal system, and by it tenants are employed to till the fields, and, in short, to perform all the duties of cultivators in consideration of a fixed reward specified in the contract. This recompense usually takes the form of a participation in the produce of the land, and is usually fixed at 50 per cent. of the harvest, the tenant supplying his own cattle and tillage implements, besides purchasing seed and contributing one-half of the land revenue and water rates. Of course, the "batai" system is variously applied between landlord and tenant in accordance with the specific conditions obtaining in the particular part or district concerned, but the above formed the basis of the contract at Feroze, which also provided for certain other minor contingencies. The Sikh is by far the best cultivator in Northern India, and this point was taken into consideration when engaging our tenants. Special attention was paid to the quality of the cattle brought by each tenant, and we laid down the following stipulation for each tenant requiring one or more rectangles at Feroze. For each square of twenty-five acres a tenant was required to furnish three pairs of bullocks; three Munahs (ploughs); one Bar harrow; one Lyallpur hoe; one Desi pattern Sohaga (levelling board); together with Kharif drills for sowing cotton.

After a sufficient number of tenants had been engaged, bi-weekly conferences were held, which each tenant was required to attend. At these meetings the use of the drills was explained together with the proved advantages of line-sowings, and the full programme of operations for the ensuing season was discussed

The tenants seemed interested in the drills, but when figures were quoted for actual yields obtained at Lyallpur and elsewhere they seemed unconvinced. The proverb "Pora Badshah, Kera Wazir ta Chhatta Fakir," which suggests that a person using the "Por" or funnel-shaped tube attached to the plough is likely to become a king, whereas anyone dropping seed by hand behind the plough, in a furrow, will only qualify as a Prime Minister, just as the individual broadcasting his seed cannot aspire to anything better than beggary, caused a good deal of laughter, but it was a long time before the truth of this proverb was accepted by the tenants.

Meanwhile a 16½ h.p. cold-starting Campbell crude oil engine was purchased, together with an 8-inch Gwynne centrifugal pump, the plant being laid down as close to the outlet as possible and just round the first large curve in the water-course.

A square tank built of "pucca" bricks and lined throughout,

3 by 5 feet, was built in the water-course in front of the engine, and at a height of 3 feet from the bed two steel girders were built into the masonry as supports for the pump. A foot valve and strainer were fitted as usual to the base of the suction pipe, which was 8 inches in diameter.

About 200 coolies—" Oads " as the men are called in the Punjab who are accustomed to work on the canals—were engaged to dig the main channel, and the work was given out to a contractor at a fixed rate per thousand cubic feet.

The work on the water-course proceeded very slowly indeed, and whilst a certain amount of care and precision had to be exercised in the matter of sloping and levels, etc., this was not the principal factor which impeded progress. The Zemindars, through whose lands the water-course had of necessity to pass for some part of its distance, were most troublesome, and in spite of the fact that the channel had been mapped out and the actual course agreed upon in consultation with these people weeks beforehand, certain elements proved very hostile, and required very careful handling. As a solitary instance of this, the following is typical of the sort of hindrance which was so difficult to avert. At eight o'clock one morning there were about 150 coolies at work on the water-course, whereas at nine-fifteen there was not a sign of one. Some villagers had assembled, and after a few minutes' altercation had declined to allow the operations to be continued, and had actually beaten the coolies engaged in the work with lathis.* All manner of inducements to the coolies to return and resume work were without avail, and we had to place the work with a second contractor. This individual evidently had not the necessary funds to finance his labour, or else he was dishonest in calculating the work done, because his coolies ran away one night, and once again it became necessary to engage a new contractor. I look back upon those days with mingled feelings of dread and amazement, and when I recollect the many occasions when I was compelled to assume the combined rôles of a Deputy-Commissioner, a Superintendent of Police, and a King Solomon, I am conscious of a deep satisfaction that difficulties which at one time seemed to defy all efforts at settlement were ultimately resolved. It often fell to my lot to determine such problematical questions as (*a*) who exactly had provoked the assault, (*b*) the precise boundary of a neighbour's land, (*c*) the most equitable solution to a dispute between the Zemindar and myself regarding the actual size of an encroachment by the water-course; and when it is remembered that in India everybody

* Lathis—heavy wooden poles.

speaks, or rather shouts, at once, that the language in the villages is neither pure Urdu nor Punjabi, but is a jungle mixture of both, and that a Punjabi Zemindar has the vaguest conception of his own boundaries, but in any case will not concede one fraction of land which he is pleased to regard as belonging to him, it seems a matter for congratulation that a solution is ever arrived at. Perhaps the only way in which to deal with this type of individual is to pursue the policy described by the Latin saying "Suaviter in modo, fortiter in re," and certain it is that one has to adopt a very firm attitude towards these villagers.

A large portion of the area taken on lease was covered with thick jungle, and a separate contract was made with some of the villagers from neighbouring "chaks" to clear this at a fixed rate per rectangle or square, the rates varying according to the denseness of the jungle. The principal trees were "khikar" (*Acacia eburnea*) and "jhand" (*Prosopis spicigera*). Logs from the former were cut up and burned in conical-shaped stacks called "kups," the resultant charcoal being taken to Lahore for sale. The "jhand" could not be similarly treated, and so the logs were sawn and used as timber in the construction of tenants' quarters, or sold to the villagers for use as firewood. As a matter of fact, about two-fifths of the total sum expended upon clearing the jungle was recouped in this manner, and the opportunity to work at jungle clearance was welcomed by the villagers, many of whom had survived two successive crop failures and were undergoing great privations in order to feed their families. Periodical crises of this nature cannot, of course, be avoided, but it nearly always happens that an increase in village crime coincides with the failure of a crop. The Mussulmans are much more improvident than the Sikhs, and in most cases when the former are overtaken by a period of misfortune, due to a crop failure, they cannot weather the stressful times without resorting to acts of unlawfulness, whereas the Sikhs, benefiting by their attention to small economies after abundant harvests, are enabled to feed themselves and their dependents during a lean time.

The jungle was infested with snakes, many of which were very deadly, and I arrived upon the scene upon more than one occasion just in time to get busy with a snake-bite lancet and crystals of potassium permanganate.

During the early summer months the villagers usually set about repairing their houses and cattle-sheds, and bargaining with the Pathans for the construction of new premises. These Pathans, having sown their wheat in the hills across the Indian frontier, trek down

to the Punjab plains and travel about in batches of six to twenty in search of work. They are very crude artisans, and their work regarded from an Occidental or an architectural standpoint is of the rudest design and quality, but it is amazingly strong, and will stand against the most persistent battering of wind and rain. They are a most complacent people, and their speech, which has a distinctly musical note, seems to stand them in good stead among other followers of the Prophet, since in my experience they usually seem to obtain bed and board gratis in the villages where they are working. Moreover, they possess that which is rare in an Oriental—an acute sense of humour—though their smiles will quickly give place to frowns and their voices assume a most truculent tone. Their clothes are invariably filthy, and one would hesitate, on this account, to brush against a Pathan whilst passing him in a crowded thoroughfare. Nevertheless, they are exceedingly robust, and work with a surprising cheerfulness in a mixture of mud and water, and under conditions which would completely embarrass their Punjabi brethren.

A party of these Pathans built a large " Walgan "—*i.e.*, a compound wall around the tenants' quarters at Feroze—for an exceedingly modest sum, and when unprecedented rains visited us in 1928 these walls remained standing after everything around them had been razed to the ground. Inside these walls, which enclosed an area of about four acres, thirty tenants' quarters, measuring 12 by 8 by 8 feet each, were built, together with cattle-sheds, stores, and quarters for two or three farm assistants. The tenants' quarters, consisting of a single room with a small verandah plastered externally with a mixture of cow-dung, bhoosa (crushed wheat straw), and mud, were divided into two sections, and were spread along two sides of the " walgan." Sikhs occupied one side and Punjabi Mussulmans the other, and in the case of the latter a " purdah " wall was built instead of the verandah for the " Zenana." Beams were supplied to the tenants for roofing, but each had to provide bhoosa, brushwood, and mud plaster with which he covered the roof of his tenement.

A well was provided inside the compound for use of the tenants' cattle, and the cattle-sheds were designed with a view to conserving manure as much as possible. A trench was provided underneath each animal to receive the urine as well as the dung, and straw was littered periodically inside the trenches, and the manure taken up from time to time and put out on the fields. In the Punjab, at any rate, cow-dung is used very largely as fuel, and the Zemindar, who has still much to learn of the advantages accruing from a systematic and regular manuring programme for his fields, relies upon legumes

to a great extent, or, in many cases, does not manure at all. I have often remonstrated with villagers, taxing them with the folly of their inattention to this important detail, but in nearly every case my arguments have been received with a bland smile, or a pile of manure has been pointed out with an indifferent gesture backed by a plausible tongue. It is customary to see manure stacked in the villages in a very conspicuous and unprotected place, where it is left to rot for a most indefinite period, the cultivator remaining sublimely indifferent to the fact that by exposure to the atmosphere and the scorching rays of the sun the pile is losing a proportion of those very ingredients which render it valuable as a dressing to the soil.

When these details had been superintended I turned my attention towards a suitable location for my bungalow, and a contractor was engaged to erect it at an inclusive charge. The bungalow was built of "kachcha" (*i.e.*, sundried) bricks throughout, save that a good high plinth of "pucca" masonry was put down as a foundation, and all arches, windows, etc., including a space at the top of the walls underneath the roof, were made of "pucca" bricks. The roof was built of box-wood supported on H-iron girders, and the whole was surmounted with a thick layer of mud plaster.

The house comprised a verandah at the front and back, a dining-room with pantry annexed, a drawing-room and office, and two bedrooms with bathrooms attached, and there was a wide and airy passage connecting the front doors with the back of the house. Special attention was given to the fire-places, which were copied from the standard pattern in canal rest-houses, and the rooms were all lofty and well ventilated. The usual kitchens and servants' quarters, garage, and outhouses were constructed of similar materials at the back of the bungalow, and a tube-well operated by a hand pump was sunk in the compound close to the bungalow to the depth of 80 feet. The floors throughout the bungalow were made of cement, and though white ants were plentiful at the start, this nuisance was largely remedied by mixing some potassium cyanide with the lime and mortar.

The contractor submitted an estimate which in the light of subsequent experience was found to be too conservative, and when the work was finally accomplished and turned over to me, I refused to complete full payment until certain minor alterations were attended to. The cement on the floors had been skimped, the drains on the roof had not been properly made and finished, and the mud plaster on the roofing had been very indifferently plastered. The contractor protested in vain, and finally left the estate for Lahore,

refusing to complete the work according to my requirements, and removing all his tools and apparatus. I followed him up with a legal notice requiring him to complete the contract within seven days, and enjoining upon him the necessity for immediate compliance, failing which I should place the remainder of the work in other hands at his account and risk.

The seven days elapsed without a response, and about six o'clock in the evening of the eighth day it commenced to rain, and poured in torrents for fifty-six hours without abatement. The drains on the roof provided an immediate justification of my worst fears, and the front verandah fell down after a few hours, and was followed, during the night, by the remainder of the bungalow. I was alone in the house at the time, and spent the first part of the night in a pair of pyjamas alternating between the roof and the basement in a frantic endeavour to repair the breaches and arrest the damage to my house and property. Towards dawn it became manifest that all my attempts to salve a portion of the bungalow were doomed to failure, and I commenced removing my goods and chattels to the comparative safety of a bush outside. In this I was assisted by one or two of my Indian assistants, who, apprehending some startling "dénouement," had braved the elements to come to my rescue. The roof toppled in as I removed the last of my medicines from the closet in my office, and I spent the few remaining hours till dawn upon a "charpai" (native bed) which I shared, sitting, with seven Indians, a similar fate having befallen the buildings at the back. The appearance of a welcome but watery sun revealed the "charpai" sunk up to the flat portion of it in mud, eight bedraggled specimens of humanity clinging to it as to a raft, and such a spectacle of desolation around the countryside as I would never have expected to have witnessed or read about save in the story of the Flood as portrayed in Holy Writ. The rain had not abated at all, and our "chota hazri" that morning consisted of liberal dosages of quinine and rain water. A bullock cart was summoned from Feroze village, but it was unable to reach us, so we started out to walk (or rather swim) to the village. Passing the "walgan" en route, I noticed that all our tenants' quarters had come down during the night, and the walls built by the Pathans only were standing. Arrived at the village, we discovered that several dwellings had been similarly dealt with by the elements, but I was at once given an opportunity to sample some of that hospitality for which the Indian Zemindar is so justifiably renowned, and I took up my residence in a mud dwelling which, while lacking space and ventilation, seemed a veritable "Ararat." Here I remained

for several months, sharing my refuge with a rat, a cow, a pigeon, and several small members of the entomological world which, in spite of their being so insignificant, did their utmost to make their presence felt.

Some days later, the rain having ceased, and emboldened by the reflection that the pigeon which had escaped through my window had not returned to roost (another instance of how history repeats itself!), I made a sortie and surveyed the damage done to my water-course and to my buildings. This was bad enough in itself, but to add to our troubles the canal had breached, and the floods had been very considerably augmented. The result of this first excursion around the estate after the storm served to depress me most abominably, and for a brief space I permitted myself to conjecture the long months of almost heart-breaking salvage work which must ensue before repairing the losses occasioned by the floods. However, the sun and the remembrance of a woman in England is good healing balm for a spirit which is temporarily bowed down with despair, and I made up my mind in the course of the morning that the next day should find me intent upon restoring the estate to some of its lost appearance. The evidence is there today in the shape of a new bungalow, new out-houses, and new accommodation for my tenants, but it has meant hard work and a considerable amount of optimism, because there is nothing so disheartening to anyone as to have to start from the beginning all over again.

I availed myself of the situation created by the "former and the latter rain" (as it says in the Prayer Book) to exhort my tenants to plough the land, but here again I had the utmost difficulty in securing their co-operation, since many of them were engaged in repairing their houses and nearly everybody said "We will plough when the water from the engine reaches our fields."

There are, broadly speaking, two main varieties of cotton grown in the Punjab—viz., (1) Country or Desi, and (2) American, and the former is much more extensively cultivated than the American types. The Indian cotton plant is tall and slender, and the American variety is a short, bushy plant. Country cotton can be sown as late as the first half of June, though it is usually put down with American cottons in April. As a matter of fact, there has been a tendency in recent years on the part of some growers to sow American cotton as late as May, in view of the fact that the later sown crop has exhibited better results in years of cotton failure. Extensive experiments have been conducted at Lyallpur to test the relative value of this policy, and it has been established that cotton sown

late has a greater rate of growth and an increased boll production in comparison with the earlier grown crop. This conclusion has not, however, I believe, been arrived at in conjunction with certain watering and manuring tests which may affect aspects of late sowing. At Feroze, of course, we were sowing cotton on land which had been covered by jungle for years, and over which cattle and sheep had been grazed, otherwise it is worth noting that cotton is a crop which gives a good return for manuring, though the ideal procedure is to grow cotton on land which has been manured *indirectly*—*e.g.*, after gram.

The land on which cotton is to be grown should be ploughed at least five times, and an irrigation is always given prior to sowing. The soil should not be allowed to dry more than is necessary to enable the bullocks to get into it, and when a crust forms on the soil immediately after sowing, the " sohaga " (levelling beam) should be used to break it up.

Both Desi and American cotton should be sown in lines, and the optimum distance between the lines is said to be 2 feet in the case of Country cotton, and 3 feet for American. Broadcast sowing is almost universal throughout the Punjab, except in those rare instances where the cultivators have heeded the advice of the Agricultural Department. Cotton sown broadcast cannot be intercultured properly, and the importance of hoeing at least once after every irrigation, until the plants are too high for this to be possible, cannot be over-estimated.

The seed is rubbed on wet ground or in cow-dung in order to remove the fibres, and thus allow the seeds to be separated from each other. The usual seed rate is about five seers per acre. It is difficult to lay down any hard-and-fast rule for the watering of cotton, but about seven waterings in all usually suffice, and a final watering about the middle of October improves the quality of the fibres of the last pickings, even though it may not greatly affect the yield. Desi cotton does not require this last watering, but if cotton is sown in very sandy soil it will require more waterings. Frequent irrigation is advantageous during August and early September because this is the time when the flowers appear.

This concludes my article, and whilst I have tried to describe as faithfully as possible some of the difficulties and problems which confronted me at Feroze, I trust that nothing I have written may be construed to mean that I have found farming in India an unpleasant experience. It has been positively the reverse. I have chosen my title because loneliness was the predominant feature of

the early days at Feroze, and although conditions of living improve with the development of the land, it is not likely that an estate such as that described above will ever offer very much in the way of society or social distractions. The writer has grown accustomed to pass months at a time without seeing a white face or hearing a word of English spoken, but as a set-off against this enforced solitude it has to be remembered that the villagers are simple and very kindly disposed folk, who respond readily to tact and fair treatment, and are hospitable in the extreme. Besides, the work abounds in interest; one is working side by side with Nature, and in working with Nature one works with God.

Received April, 1930.

"MAGNA EST VERITAS ET PRÆVALEBIT"

OR

FLOWERING CURVES AND THE GENTLE ART OF MISQUOTATION

BY

N. W. BARRITT.

Dr. Balls always commands a good reading public, and anything he has to say about cotton must receive attention. His criticisms* of my recent article on "Plant Development Curves and the Branching of Cotton" certainly call for a reply.

In this article I showed how the data given in *Bulletin* No. 90, issued last year by his department, did not support the conclusions contained in *Bulletin* No. 87. Unfortunately, Dr. Balls appears to have misunderstood my remarks. He accuses me of misquoting Brown, which is very curious since Brown said nothing to quote, and is therefore credited with prudence. My remarks happened to be original, and for this iniquity I am pilloried as having made the absurd claim "that yield follows quality and that strength follows waste." I agree that this is trite nonsense, but I did not say it. What I actually said was "that the percentage waste figures show a progressive increase as the strength of the yarn decreases," which I think is the opposite of what Dr. Balls would have the reader believe. He then goes on to ask "What is quality in Cotton ?" and his answer, contained in 360 pages published by Macmillan, does not decide whether it is to be determined by the spun yarn, the woven cloth, or the finished garment in the wash-tub. But *revenons à nos moutons*. I claim that all the figures for the 1927 crop showed that the steep flowering curve is inferior to the flat curve. The additional figures for 1928 quoted by Dr. Balls also support this conclusion. Giza 7, grown at Mensafis, gives the highest yield and the least waste, and if Dr. Balls had turned over a few more pages, he would have found that the flowering curves at Mensafis in 1928 (the 30th chart in the *Bulletin*) are all of the flat type, similar to those at Fashn in 1927. Thus it is only by falsifying my statements that he is able to make a semblance of misrepresentation on my part. With regard to *Bulletin* No. 90, the author has seen fit to publish forty charts without either reference numbers or discussion of their salient features. Personally

* This Journal, Vol. VII., No. 3, p. 218.

I do not appreciate caution of this nature. It neither helps the reader nor convinces him that the author suffers only from modesty.

I am next accused of misquoting Bailey and Trought with respect to the lack of coincidence between growth and flowering curves. I quoted correctly from *Bulletin* No. 65, dated June, 1925, whilst Dr. Balls quotes from *Bulletin* No. 60, dated February, 1925, but does not say so. It appears that Bailey and Trought revised their cautious statement of February, for five months later, in *Bulletin* No. 65, they leave no doubt about the matter at all. After saying (p. 11) that there is no relation between the two curves at any interval, they conclude that the daily fluctuation of rate of flowering does not depend on fluctuations in rate of differentiation or rate of elongation. I cannot in this instance accuse Dr. Balls merely of practising the gentle art of misquotation. I gave the number of the *Bulletin*; Dr. Balls gives the page without saying that it refers to an earlier *Bulletin*, so that the busy reader would naturally conclude that I had misquoted the authors.

It is not possible to comment upon the unpublished data that Dr. Balls has since obtained at Giza in support of his theory, but at present the conclusions of Bailey and Trought still hold the field. It will be interesting to see how Dr. Balls will effect a correlation between the flat flowering curves, such as those obtained at Fashn, with any growth in height curve.

The accusation that I misquoted Williams with regard to the development of the pink bollworm is entirely unfounded. The further quotation brought forward by Balls merely confirms my suggestion that the preference for a steep flowering curve is probably based on the idea of securing a crop capable of being picked in one operation. The true significance of the flowering curve, however, is *physiological*, and from this standpoint both reason and horticultural experience are on the side of the flat or continuous flowering curve (See " Research Items," *Nature*, p. 872, June 7, 1930).

With regard to the formation of a cork layer as the cause of abscission, Balls admits that I quoted him correctly, but objects to my making use of what he calls a casual remark! In his earlier book, it is true, he despises the friendly cork, and prefers the terms " special tissue " and " callus." Are we to conclude that his standard work " Raw Cotton " (Macmillan, 1915) was written in a casual and more genial moment? Chapter III. not only contains this casual remark about the cork layer, but also the amazing fiction of the advancing row of nuclei in the developing palisade layer of the seed coat. (See *Annals of Botany*, vol. xliii., No. 171, 1929.) Is " Raw

Cotton" the "well of inaccuracy" into which Dr. Balls says I have dipped my pitcher too often?

Dr. Templeton regrets that I do not believe in his steep flowering curves. He misrepresents me as advocating close planting, which, he says, would result in a steep flowering curve, whilst his chief, Dr. Balls, on the previous page, has just described the cotton crop at Fashn (the district where flat curves are produced) as the closest sown in Egypt. Is it too much to expect consistency or agreement between experts working in the same laboratory? Cannot Dr. Templeton understand that optimum spacing does not necessarily imply close planting? And is it not rather futile to pretend to breed a type of cotton plant with a steep flowering curve when the same pure line will produce either type of curve according to district or season of growth?

In conclusion, I fully realize Dr. Balls's natural aversion to controversial matters. Life would be much easier if we could all believe what the experts tell us without question. Unfortunately I am no longer the trusting pupil, and regret very much to appear to quarrel with my teacher. I can truly say that, whatever adverse criticisms I have to make of his scientific works, I retain a great admiration for his literary style. I have tried to emulate him in vain, and I am glad he has recognized at least one instance of deliberate plagiarism, though only practised in irony. There are other instances for the amusement of those who care for such matters. But for research purposes I am convinced that the microscope is mightier than the pen. When legs stick out of the Procrustean bed,* is it wiser to cut them off or only just pull them?

I would also like to assure Dr. Balls that I enjoyed every day of my brief career in Egypt, and far from having a sour view of life, I still believe in the sweet uses of adversity.

* See "Quality in Cotton," p. 242. Macmillan, 1928.

ROTHAMSTED,
July 9, 1930.

COMPARATIVE COTTON PRICES

BY

JOHN A. TODD, M.A., B.L.

THE history of cotton prices during the season 1929-30 has been unique owing to the fact that the markets for the two main crops, American and Egyptian, have been subject to Government intervention which has entirely dislocated the ordinary operation of supply and demand, and has produced a very abnormal situation.

In the first place, as will be seen from Table I., the general level of prices of all the principal varieties has been much lower than the previous season, and that, not so much because of larger crops, but as the result of financial dislocation throughout the world as a whole, which has affected the prices of all staple commodities. But the outstanding feature of the season has been the attempts of the two Governments to support the price of cotton, and the extraordinary complications in which these efforts have resulted.

The trouble began with American cotton, primarily as the result of the Wall Street crash in October, 1929. Just before that occurred the United States Government had set up the Federal Farm Relief Board, with the object of assisting the Co-operatives to extend their work of lending to the growers on the cotton placed with the Co-operatives. Before this announcement was made in the middle of October, prices had begun to fall rather sharply as the result of the unusual rapidity with which the American crop was being moved to market, and the first effect of the Government announcement was to check the fall. When the Wall Street crash came, about October 25, the hope of Government assistance tended to minimize the effect on cotton, which for a time withstood the storm fairly well. About the last week of January, however, the market seemed suddenly to realize that the fight against the downward tendency was too much for them, and cotton fell very heavily. This led to a further unexpected development. It turned out that the Co-operatives, as well as holding considerable quantities of actual cotton, were heavily long on the futures market and were unable to meet their differences; and the Farm Relief Board, in order to avert the bankruptcy of some of the Co-operatives, found it necessary to give them financial support. As the date of maturity of the contracts

approached it became known that the Co-operatives intended to take them up, with the result that the market, including both speculative interests and certain large spot houses, found it necessary either to buy in their futures or to deliver the cotton. The result was to force the prices of near months up to practically the level at which the Government had authorized the Co-operatives to lend—about sixteen cents.

But as the Co-operatives' holdings were entirely in the near months, there was no such support for distant months, which were therefore left to the open market. The result was to create a heavy discount on distant months, which caused very serious dislocation in the market, and indirectly contributed to the serious restriction of demand for actual cotton, which had begun as the result of the Wall Street crash and became still more marked as the season advanced. In June, partly owing to trade conditions and partly to the growing expectation of a large crop in 1930, a further slump occurred, in the course of which the premium on the near months practically disappeared. As the result of all this the Farm Relief Board, through the Co-operatives, holds about one and a half million bales of cotton, or approximately a quarter of the total World's Carry-over.

In Egypt the action of the Government was more direct. From November onwards they fixed prices for the near month, both of Sakel and Uppers, and tenders at these prices were so large that by the end of the season the Government held over three million kantars, or fully half of the world's stock of Egyptian cotton.

As the result of this artificial control of the prices of American and Egyptian, the relative prices of the other crops were thrown seriously out of gear. In effect, the prices of Outside Growths (except Egyptian) followed that of American, with the result that Egyptian became the dearest of all cottons, for the differences between Uppers especially, and all the other growths which normally compete with it, *e.g.*, Brazilian, Peruvian (Tanguis), East African, etc., widened abnormally. The effect, of course, was to intensify the competition of these Outside Growths, which had already begun to be felt very severely both by Egyptian and American.

A special feature of this competition was the presence on the European markets of an unusual quantity of São Paulo (Southern Brazil) cotton. This cotton, which is of American type, is generally retained by the local mills in Brazil, but owing to a combination of circumstances (a larger crop than usual, the accumulation of manufactured cotton goods in advance of a raising of the tariff, and financial difficulties), they were unable to do so this year, and a

large part of the cotton was exported. In Liverpool it was very welcome, as it helped to fill the gap created by the failure of the Texas crop. Thus everything has tended to accentuate the conditions under which, during the past year, the consumption of Outside Growths as against American has risen to record figures.

TABLE I.—HISTORY OF COTTON PRICES, 1899–1930.

SEASON'S AVERAGES.

Season.	*Liverpool Prices (Pence per Lb.).* *Sea Island*	*Brazil.*	*American.*	*Indian.*	*Egyptian.*	*Alexandria.*	*American Price of Upland.*	*Index Numbers of General Prices.*	
	Cents per Lb.	Pernam Fair.	Middling.	No. 1 Fine Oomra	F. G. F. Brown.	Dols. per Kantar.	Cents per Lb.	Year.	
1899–00	16·70	5·06	4·87	4·40	6·81	*12·28	7·60	1900	100·0
1900–01	16·40	5·50	5·16	4·37	6·87	13·80	9·30	1901	96·7
1901–02	19·30	4·87	4·78	4·19	6·31	10·42	8·10	1902	96·4
1902–03	†25·00	5·57	5·44	4·47	8·44	13·65	8·20	1903	96·9
1903–04	28·40	5·16	6·94	5·56	8·56	16·65	12·16	1904	98·2
1904–05	27·12	5·25	4·93	4·62	7·37	13·97	8·66	1905	97·6
1905–06	26·38	6·23	5·94	5·00	9·25	15·99	10·94	1906	100·8
1906–07	36·70	6·97	6·38	4·87	10·37	19·16	10·01	1907	106·0
1907–08	35·59	6·79	6·19	5·03	8·81	18·21	11·46	1908	103·0
1908–09	23·39	5·84	5·50	4·94	8·44	15·46	9·24	1909	104·1
1909–10	32·85	8·34	7·86	6·31	13·12	23·30	14·29	1910	108·8
1910–11	35·62	8·27	7·84	7·03	10·75	20·66	14·69	1911	109·4
1911–12	23·73	6·70	6·09	5·63	9·56	17·25	9·69	1912	114·9
1912–13	25·00	7·11	6·76	6·16	9·79	18·28	12·20	1913	116·5
1913–14	23·47	7·47	7·27	5·88	9·45	19·02	13·49	1914	117·2
1914–15	22·00	5·71	5·22	4·46	7·34	12·01	7·94	1915	143·9
1915–16	27·00	8·22	7·51	6·09	10·42	19·28	11·99	1916	186·5
1916–17	50·00	13·03	12·33	10·32	21·56	37·81	18·41	1917	243·0
1917–18	80·00	24·13	21·68	18·78	‡30·97	38·52	28·86	1918	267·4
1918–19	65·00	23·96	19·73	18·13	27·85	37·20	30·36	1919	296·5
1919–20	*Peruvian*	30·00	25·31	19·23	60·34	87·81	38·21	1920	365·7
1920–21	*Tanguis*	13·24	11·89	9·20	30·24	34·50	16·08	1921	229·7
1921–22	Good	11·40	11·37	9·60	19·75	34·28	17·78	1922	185·0
1922–23	16·87	14·62	14·92	11·14	17·29	30·71	24·06	1923	185·3
1923–24	20·15	18·20	17·66	13·35	21·55	39·79	31·67	1924	193·6
1924–25	18.21	14·67	13·76	11·95	29·82	39·49	24·27	1925	185·4
1925–26	15·15	11·09	10·77	8·97	20·05	30·47	19·88	1926	172·5
1926–27	9·95	8·32	8·15	7·18	15·39	21·49	12·96	1927	164·7
1927–28	12·52	11·36	11·17	9·21	19·39	29·69	19·72	1928	163·4
1928–29	12·25	10·72	10·52	8·03	18·14	25·88	18·92	1929	158·9
1929–30	10·44	8·67	9·09	6·39	14·52	§20·30	17·24	1930	‖144·6

* These figures are F. G. F. Brown till 1914, since then composite figures embracing G. F. Sakel, G. F. Ashmuni, and G. F. Brown.

† South Carolina. ‡ F. G. F. Sakel.

§ Eight months only. ‖ Seven months.

TABLE II.—SPOT PRICES OF AMERICAN AND EGYPTIAN COTTON IN LIVERPOOL, ALEXANDRIA, AND NEW ORLEANS ON THE LAST FRIDAY OF EACH MONTH

Month.	*Liverpool.*					*New Orleans American Middling.*	*Alexandria*	
	American Middling.	*Egyptian F G. F. Sakel.*		*F. G. F. Uppers.*			*F. G. F. Sakel.*	*F.G.F. Uppers.*
	Pence per Lb.	Pence per Lb	Premium per Cent.	Pence per Lb	Premium per Cent.	Cents per Lb.	Dollars per Kantar.	Dollars per Kantar.
1927–28.								
August ..	11·15	19·45	*75*	15·45	*39*	21·30	38·62	28·68
September	11·57	18·75	*62*	14·80	*28*	21·56	37·00	27·18
October ..	11·66	18·80	*61*	15·20	*30*	20·31	37·00	28·56
November	11·14	18·35	*65*	14·55	*31*	19·51	35·25	26·81
December	11·06	17·75	*61*	14·40	*30*	19 92	34·25	27·06
January ..	10·32	17·25	*67*	13·35	*29*	17·91	33·25	24·68
February ..	10·40	18·25	*75*	13·55	*30*	18·51	34·50	25·43
March ..	10·86	20·15	*85*	14·60	*34*	19·27	40·25	27·56
April ..	11·61	21·15	*82*	15·55	*34*	21·08	41·37	29·06
May ..	11·46	21·55	*88*	15·05	*34*	20·46	41·75	27·68
June ..	12·49	21·30	*71*	15·30	*23*	22·63	40·75	28·06
July ..	11·73	19·70	*68*	14·20	*21*	20·92	38·87	25·93
1928–29.								
August ..	10·47	18·85	*80*	12·80	*22*	18·50	36·37	23·68
September	10·72	17·90	*67*	12·00	*12*	18 53	34·12	21·43
October ..	10·51	18·05	*72*	12·40	*18*	18·55	35·00	22·56
November	10·97	19·40	*77*	12·65	*15*	19·57	37·87	23·06
December	10·64	19·35	*82*	12·20	*15*	19·36	37·87	23·06
January ..	10·48	19·10	*82*	12·32	*17*	18 91	36·50	21·81
February	10·49	17·85	*70*	12·10	*15*	19·00	36·62	23·43
March ..	10·96	19·40	*77*	12·80	*17*	19·75	37·50	23·81
April ..	10·23	17·95	*75*	11·86	*16*	18·59	35·00	22·56
May ..	10·20	17·25	*69*	11·38	*11*	18·52	32·50	20·68
June .	10·33	16·20	*57*	11·18	*9*	18·76	31·62	21·18
July ..	10·58	17·05	*61*	11·54	*9*	18·89	32·62	21·06
1929–30.								
August	10·58	17·25	*63*	11·75	*11*	19·10	33·25	21·43
September	10·20	16·50	*62*	11·30	*11*	18·14	32·12	20·68
October	9 96	15·55	*56*	10·87	*9*	18·05	28·62	19·81
November	9·59	14·65	*53*	10·63	*11*	17·17	27·12	19·06
December	9·51	14·20	*49*	10·44	*10*	17·11	26·87	19·18
January ..	8·85	14·25	*61*	10·34	*17*	15·89	26·87	19·25
February ..	8·49	13·55	*60*	10·11	*19*	15·16	26·37	19·18
March ..	8·44	14·20	*68*	10·27	*22*	15·48	27·37	19·06
April ..	8 74	14·30	*64*	10·42	*19*	15·54	27·37	19·43
May ..	8·58	13·65	*59*	10·11	*18*	15·45	27·62	19·43
June ..	7·74	12·55	*62*	9·58	*24*	12·85	27·62	19·25
July ..	7·47	12·40	*60*	9·44	*26*	12·75	27·37	18·62
1930–31.								
August ..	6·64	10 45	*57*	8·50	*28*	10·80	25 87	14·00

TABLE III.—MONTHLY SPOT PRICES OF VARIOUS KINDS OF COTTON IN LIVERPOOL, 1927–30.

ON THE LAST FRIDAY OF EACH MONTH. FROM THE LIVERPOOL COTTON ASSOCIATION'S WEEKLY CIRCULARS.

(*For American in Liverpool and New Orleans—and Egyptian in Liverpool and Alexandria—see Table II.*)

Seasons.	*Peruvian.*			*Brazilian.*		*West African (Middling).*	*East African (Good Fair).*	*Indian (No. 1 Fine Oomra).*	*Percentage of Indian on American.*
	Tanguis (Good Fair).	*Smooth (Good Fair).*	*Rough (Good Fair).*	*Sao Paulo (Fair).*	*Pernam (Fair).*				
1927–28.									
August ..	12·25	12·00	11·50	10·65	11·40	10·90	14·40	9·65	*87*
September ..	12·67	12·42	12·25	10·92	11·67	11·17	14·60	9·85	*85*
October ..	12·66	12·41	12·00	10·91	11·66	11·16	14·35	9·70	*83*
November ..	12·14	11·89	12·00	10·39	11·14	10·74	13·90	9·25	*83*
December ..	12·06	11·81	11·75	10·56	11·31	10·91	13·80	9·15	*83*
January ..	11·27	11·02	11·50	9·87	10·52	10·12	13·00	8·50	*82*
February ..	11·45	11·35	11·25	9·95	10·60	10·20	13·10	8·60	*83*
March ..	12·21	12·11	12·25	10·56	11·21	10·81	14·00	8·80	*81*
April ..	12·86	12·76	12·75	11·36	11·86	11·41	14·80	9·40	*81*
May.. ..	12·76	12·66	13·00	11·26	11·76	11·36	14·65	9·20	*81*
June ..	13·79	13·69	13·50	12·29	12·79	12·39	15·70	10·00	*80*
July.. ..	12·98	12·73	12·75	11·48	11·98	11·58	14·50	9·10	*78*
1928–29.									
August ..	11·77	11·52	12·00	10·27	10·77	10·37	13·05	8·05	*77*
September ..	11·73	11·48	12·25	10·23	10·73	10·33	12·55	7·85	*73*
October ..	11·91	11·66	13·00	10·31	10·81	10·51	12·40	7·95	*76*
November ..	12·42	12·17	13·00	10·82	11·32	11·02	12·75	8·55	*78*
December ..	12·04	11·74	13·00	10·39	10·99	10·74	12·55	8·40	*79*
January ..	11·88	11·58	13·00	10·23	10·83	10·58	12·05	8·20	*78*
February ..	11·94	11·44	13·00	10·19	10·79	10·54	11·80	8·15	*78*
March ..	12·41	11·91	13·00	10·56	11·16	11·01	12·10	8·50	*78*
April ..	11·73	11·23	13·00	9·88	10·48	10·33	11·35	7·65	*75*
May.. ..	11·70	11·20	13·00	9·85	10·45	10·30	11·25	7·55	*74*
June ..	11·63	11·13	13·00	9·68	10·28	10·33	11·20	7·75	*75*
July.. ..	11·83	11·28	13·00	9·93	10·38	10·53	11·35	7·95	*75*
1929–30.									
August ..	11·68	11·28	13·00	9·93	10·38	10·53	11·10	7·95	*75*
September ..	11·25	10·95	13·00	9·50	9·95	10·20	10·75	7·65	*75*
October ..	11·06	10·76	12·75	9·31	9·76	10·01	10·56	7·45	*75*
November ..	10·54	10·34	12·25	9·14	9·24	9·59	10·14	7·20	*75*
December ..	10·46	10·16	12·25	9·06	9·16	9·51	10·06	7·10	*75*
January ..	9·60	9·50	12·25	8·50	8·50	8·85	9·40	6·35	*72*
February ..	9·29	9·19	12·25	8·09	8·09	8·54	9·09	5·80	*68*
March ..	9·24	9·14	—	8·04	8·04	8·49	9·14	5·65	*67*
April ..	9·34	9·09	—	7·99	7·99	8·59	9·24	5·65	*65*
May.. ..	9·18	8·93	—	7·93	7·93	8·53	9·18	5·65	*66*
June ..	8·29	8·04	—	7·04	7·04	7·64	8·29	4·85	*63*
July.. ..	7·97	7·82	—	6·72	6·72	7·42	8·17	4·35	*58*
1930–31.									
August ..	7·14	6·94	—	5·94	5·94	6·59	7·34	4·10	*62*

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

429. PROGRESS ON THE SUKKUR BARRAGE. (*Times*, June 4, 1930.) The world's largest coffer dam, in the bed of the River Indus, was removed and all underwater work completed on the Sukkur Barrage on May 31, according to schedule.

The Sukkur scheme, which was begun in 1923, comprises a barrage nearly a mile long across the River Indus below the gorge at Sukkur, and a network of canals and distributaries of a total length of over 6,000 miles, which will irrigate some 6,000,000 acres. The project, it is estimated, will cost more than £15,000,000. It is expected that the canals will be opened for irrigation in 1932.

430. THE COTTON INDUSTRY OF INDIA. By A. S. Pearse. (*Int. Federn. of Master Cotton Spinners and Manufrs. Asscns., Manchester*, 1930. Price 21s. net.) Since the war the cotton mill industry of Asia has developed rapidly, the increase in the total number of spinning spindles in Japan being 4,422,456; China, 3,399,000; India, 2,409,858. Owing to the longer hours of work, speed of spindles, etc., it is considered that these numbers may be considerably augmented. Lower wages do not form so important a factor as is usually supposed. Japanese imports into India reached 521,000,000 yards in 1929, against 1,263,000,000 yards from Britain. A somewhat unfavourable account is given of the methods and machinery of many mills, and of the Indian worker, and it is stated that, as in other countries, " the pioneer centres have rested too long on their laurels." The introductory chapter ends with an analysis of the various factors and conditions, comparing India with Japan.

The author has included some excellent illustrations in the book.

431. THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH: ITS CONSTITUTION, AIMS, AND FUNCTIONS. By Diwan Bahadur Sir T. Vijayaraghavacharya, K.B.E. (*Agr. J. of India*, xxv., Pt. II., 1930, p. 85.) In this paper, read at the Indian Science Congress, Allahabad, in January last, the author stated that the Royal Commission on Agriculture devoted a good deal of attention to an examination of means by which the Government of India could do more than in the past to promote the improvement of Indian agriculture. As a result of the deliberations of the Commission the Imperial Council of Agricultural Research was constituted by Government Resolution No. 826-Agric., dated May 23, 1929, for the following objects:

(*a*) The promotion, guidance, and co-ordination of agricultural and veterinary research throughout India.

(*b*) The training of research workers under a scheme of research scholarships, or in other ways.

(*c*) The collection and dissemination of information in regard not only to research but to agricultural and veterinary matters generally.

(*d*) The publication of scientific papers, etc.

432. INDIAN CENTRAL COTTON COMMITTEE. In the President's speech at the twenty-first meeting of the Committee, held on June 30 last, the following matters were dealt with: The extension of the provisions of the Cotton Transport Act to the Central Provinces and Indore; the watering of cotton in gins and presses; the decision of the Committee to finance the extension of improved varieties of cotton in the Provinces.

433. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1930. By A. J. Turner. (*Tech. Bull.*, Ser. A., No. 14, Indian Central Cotton Committee, 1930.)

Gives the results of the tests on the standard cottons of the seven seasons, 1923-30. As in former editions, Agricultural Details, Grader's Reports, Fibre Particulars, Spinning Tests Reports, and Remarks, are given for each of the twenty-one standard Indian cottons. The most important new feature is the inclusion of the results for a new standard cotton—Jayawant—the distribution of which has just begun. Jayawant is a Kumpta cotton which has the valuable property of being highly resistant to wilt, which normally takes a heavy toll of the cotton in the Kumpta area of the Bombay Presidency. Except in its resistance to wilt, Jayawant closely resembles the other Kumpta cotton, Dharwar I., which it is intended to displace; Jayawant has actually been derived by crossing Dharwar I. with Dharwar II., another pure-line selection of Kumpta.

One of the Dholleras cottons of Bombay—viz., Wagad 4—has ceased to figure among the standards. Wagad 4 has invariably given a better spinning performance than Wagad 8, but tests over a number of seasons have shown it to possess the fatal defect of being a comparatively poor yielder, and its distribution has therefore been discontinued.

(The results do not lend themselves to condensation, and should be consulted in the original.—Ed.)

434. Spinning Test Reports on East India Cottons. By A. J. Turner. (*Indian Cent. Cot. Comm. Tech. Circs.*, Nos. 23-33, 1930.) The samples were supplied by the East India Cotton Association as specimens of fair average cotton of the commercial crop. The circulars contain the grader's report and spinning test results for Fine and Superfine Khandesh; Fine and Superfine C.P., No. 1; Fine and Superfine Berar; Fully Good and Fine Muttia; Latur, Nanded, and Punjab-American; Dholleras and Kadi-Viramgaum; Broach; Jagadia Farm, Surat and Navsari; Kalagin; Farm Western, Bijapur and Bagalkote; Coompta, Cambodia, and Karunganni cottons for the 1929-30 season.

435. Soils of the Bombay Presidency. By Rao Bahadur D. L. Sahasrabuddhe. (*Bull. No.* 160, Dpt. of Agr., Bombay, 1929. Obtainable from the Supt., Govt. Printing and Stationery, Bombay, or the High Comr. for India, 42, Grosvenor Gardens, London. Price: annas 7, or 8d.) A detailed account which should be consulted by those interested in the practice of agriculture in the Presidency. The subject is dealt with under the following headings: Introduction; Soils of the Bombay Presidency as a whole; Soils of Gujerat; of the Deccan Districts; of the Western Coast Districts; of the Karnatak.

COTTON IN THE EMPIRE.

436. The following reports have recently been received:

Empire Marketing Board. "4th Annual Report, 1929-30."
Report of Conference of Empire Meteorologists, 1929.
The Journal, 1930. South-Eastern Agricultural College, Wye.
Nigeria: Ann. Rpt. of the Northern Provinces, 1928.
Tanganyika: Tsetse Reclamation, Ann. Rpt., 1929.
Tsetse Research, Ann. Rpt., 1929.

437. British Cotton Growing Association. The Twenty-fifth Annual Report contains the usual interesting information. It is stated that the cotton trade is gradually realizing the importance of Empire and outside growths of cotton, and the increase in production is already having an effect upon the price for American and Egyptian. Empire and other miscellaneous growths can now be purchased on a reasonable basis in comparison with American, and given normal trade con-

ditions there is no doubt that spinners will use them more extensively in the future, as supplies can now be obtained throughout the year. The total number of bales dealt with by the Association during 1929 was 124,790, of a value of £3,683,567. The work of the Association in the various countries of the Empire is described. The Report is well illustrated, and the usual statistical appendices are included.

438. FOURTH ANNUAL REPORT OF THE EMPIRE MARKETING BOARD, 1929-30. (H.M. Stat. Off., price 1s. net.) An account of the work of the year given under the following heads: Progress in Empire Marketing; Grants for Research and Development; Economic Investigations and Marketing Enquiries; Publicity.

In connection with cotton diseases, a grant of £600 capital and £200 per annum for four years, has been made to the Rothamsted Experimental Station for investigation on the "Blackarm" or "Angular Leaf-spot" disease of cotton, with special reference to its relation to soil and air temperatures, atmospheric humidity, and other environmental factors. The organism causing the disease (*Bacterium malvacearum*) is being studied, and several strains, some of which attack the cotton plant, some of which are innocuous, and some of which appear to be intermediate, have been isolated. Six tanks in which plants are grown under controlled environmental conditions were completed in February, 1929, and it is now proposed to repeat and confirm the experiments already carried out, and to follow up a number of promising lines of research. The results are likely to be of value to the Sudan, Nigeria, and Uganda, and co-operation with the authorities in these countries is being maintained.

[*Cf.* Abstracts **249, 548, 549.**]

439. ASIA: CEYLON. *Cotton Cultivation.* (*Bull. Imp. Inst.*, xxviii., **2.** 1930, p. **204.**) According to the Annual Rpt. of the Dept. of Agr., 1929, a cotton-breeding station was opened at Tissamaharama during the year. Its establishment has arisen out of the need for the production of good seed for distribution, and breeding work will be undertaken in time. The station is situated in an area in which extension of cotton-growing is likely to take place. Trials are in progress with imported Indian types (Kumpta, Karunganni, and Uppam), and a uniformity trial with Cambodia cotton, which will determine the size of plot for future work, has been laid down. The results of spacing, manurial, and variety tests at the various stations of the southern division were of little value owing to the difficulty of weed control. The early-weeded plots gave double the yields of the late-weeded plots.

440. IRAQ. *Cotton Growing.* (*Times Trade and Eng. Supplt.*, May, 1930, p. 50.) The salinity of the soil has interfered with the prospects of the cotton crop, which, after reaching 5,200 bales in 1928, was expected to show a further advance in 1929, but last year the crop was only 4,700 bales, although a larger area was under cultivation. It is hoped that as the result of the activities of the British Cotton Growing Association, of the Governmental Farm at Rustam, and of the forthcoming operations of the Latifiyah (Iraq) Estates, Limited (a transformation of the old Diyala Plantations Syndicate), which have recently completed the main canal essential to the irrigation of a very promising 60,000 acres south of Baghdad, the future of the cotton industry will become brighter.

441. AFRICA: NIGERIA. *The Eighth Ann. Bull. of the Agr. Dept., Nigeria,* **1929,** gives particulars of various experiments with cotton—including varietal, rotation, yield, spacing, manurial, ridging, and time of planting tests, and experiments on growing cotton through yams—at Moor Plantation Ibadan, Ilorin, Samuru, Kano, and Benue Province. The investigations to test the exhaustibility of the crop were also continued.

442. *Cotton Experiments,* 1929. (*Bull. Imp. Inst.*, xxviii., **2,** 1930, p. **205.**) The Senior Entomologist, Mr. F. D. Golding, states that survey work identical with

that carried out in the two previous seasons is in progress at Ilorin and Bode Sadu. Two one-twentieth acre plots of improved Ishan A and two of Native cotton (*G. peruvianum*) are being studied at Ilorin, both varieties being grown through yams. At Bode Sadu the Superintendent of Agriculture, Ilorin, sowed cotton on two blocks each 2¼ acres in extent. Each block consisted of ten plots of Native cotton, four of Ishan A from Ibadan, and four of Ishan A from Ilorin, the cotton being grown as a sole crop. Block A is a heavy blackish soil and Block B a gravelly reddish soil. The survey is being carried out on two one-twentieth acre plots of each type of cotton in each block. The results up to December 29, 1929, are summarized below.

BODE SADU.

	Flowering Zenith.	*Flowers produced per Acre.*	*No. of Bolls on Plants.*	*No. of Bolls Harvested.*	*Percentage of Bolls Shed or Mummified.*
Block A.					
Native ..	Nov. 2	112,760	60,670	14,310	35
Ib. Ishan ..	„ 23	170,360	98,890	—	43
Il. Ishan ..	„ 30	126,400	71,240	—	46
Block B.					
Native.. ..	Nov. 2	120,070	29,180	26,980	54
Ib. Ishan ..	„ 16	80,320	27,130	—	66
Il. Ishan ..	„ 16	88,710	26,820	—	70

The difference in flower production between the two Ishans in Block A is partly due to poor soil on one plot of Ilorin Ishan. The boll loss percentages in Block A are typical of the varieties concerned, while those in Block B are excessive. The principal difference between the frequency of lesions of various types and the sheds and mummies from the two blocks was the greater proportion of bolls bearing bug punctures in Block B. Both stainers and plant bugs, especially *Halydicoris scoruba* Dall., were more numerous in Block B.

It is not yet possible to prognosticate the results of the yield trial. Bacterial disease, jassids (mainly on Native cotton), *Helopeltis* spp., bollworms and various plant bugs have all played a part in limiting yield, the *Helopeltis* spp. being the most important pests of the season.

ILORIN.

Only 0·61 inches of rain fell between July 19 and August 19. Competition from the yam crop on poor soil retarded the growth of the plants to a marked degree. Between August 22 and October 11, 25 per cent. of the Ishan and 14 per cent. of the Native plants died, many being attacked by Blackarm. The results are summarized as follows:

	Flowering Zenith.	*Flowers produced per Acre to Dec. 28.*	*No. of Bolls on Plants to Dec. 28.*	*Percentage of Bolls Shed or Mummified.*
Native	Dec. 14	35,290	28,890	21
Ishan	„ 14	64,120	40,620	46

A trap crop experiment, in which one ridge surrounding one acre of Ishan A was sown with bulrush millet, proved successful against the leaf-eating weevil, *Siderodactylus sagittarius*, Oliv.

443. *The Ishan Cotton Plant under Mixed Cultivation*—I. By C. B. Taylor, E. H. G. Smith, and C. J. Lewin. (*Eighth Ann. Bull. of the Agr. Dept., Nigeria*, 1929, p. 142.) During the season under review it has been shown that:

1. Due to intercropping, the yield, boll production and flower production of cotton was depressed by about 30 per cent.
2. Until the cessation of the competitive effect of the yam crop, the growth of the plant body was depressed by about 30 per cent., thereafter the intercropped plants achieved some measure of recovery.
3. Intercropping was without influence on the following: Shape of the plant; shedding; boll weight; period of maximum delivery of the crop; lint length.
4. There is some evidence that intercropping has a depressing effect on ginning percentage.
5. The competitive effect of the yam plant was confined to a radius of 3 ft.

[*Cf.* Abstract **509**.]

444. NYASALAND. *Cotton Industry*, 1929. (*African World*, July 12, 1930.) "Cotton, the great native produced crop, shows a considerable increase even over the record 1925 year. The export for 1929 was 2,121,618 lb. of cotton and 1,932,892 lb. of cotton seed. As in recent years, the crop was purchased by the British Cotton Growing Association, the total sum disbursed to growers amounting to £61,000."

445. *Cotton Prospects*, 1929-30. The latest report received is to the effect that the prospects for the cotton crop are excellent, and in the absence of any untoward happenings, further material development should take place.

446. SOUTHERN RHODESIA. *Cotton Cultivation.* (*Rpt. of the Sec. Dept. of Agr., S. Rhod.*, 1929.) From the report of the Cotton Specialist we learn that the seed of U. 4 issued to the end of 1929 was sufficient to plant 10,000 acres. The season did not turn out to be a favourable one for cotton, which fact gave greater confidence in U. 4 than would have been the case had it been grown in a year better suited to the crop. It is a firm conviction of those engaged in establishing the industry, that this variety will do very well in many districts. The crop was successful, in spite of the unfavourable season, in about 80 per cent. of cases.

Mr. Cameron states that in order to improve the quality of the general seed supply next year (1930) a scheme has been evolved whereby it is hoped that this desirable object may be achieved. The seed from specially selected plants was bulked up at the Cotton Breeding Station, and issued in 10 lb. packets at the price of £1 per packet. The object in making such a high charge was to ensure that the seed would receive the treatment which it merits. The success of the scheme can be judged from the fact that the demand far exceeded the supply, and the packets had to be balloted for. The ready response of farmers to this method of improving seed stocks augurs well for the future of the cotton-growing industry. One hundred and twenty-four packets were issued this season, and it may be safe to assume that sufficient seed of this first, improved strain will be available next season to plant upwards of 10,000 acres.

447. *Cotton at Chipoli.* (*Rhod. Agr. Jour.*, xxvii., 7, 1930, p. 694.) The yield of some 70 acres of U. 4 cotton at Chipoli, Shamva district, averaged nearly 1,000 lb. of seed cotton to the acre, the cotton following maize, which yielded from 11 to 12 bags per acre. About 200 lb. of rock phosphate was applied broadcast per acre before the cotton was planted. The land varied from good

red loam to a much poorer soil, the best cotton being grown on the smaller plants on the lighter soil. Stainers were numerous, but bollworms were absent. The total rainfall was 35 inches.

The above results are excellent, but have not been obtained throughout the Colony sufficiently often to justify them being considered as typical; they do, however, demonstrate the promising nature of U. 4 cotton in the absence of severe bollworm conditions.

[*Cf.* Abstr. **545** and **546**.]

448. SOUTH AFRICA. *Cotton Crop.* (*Crops and Markets*, viii., **10**, 1930, p. 222.) The production of seed cotton this season (1929/30), both in the Union and Swaziland, is estimated at 19,181,000 lb. or approximately 11,500 statistical bales of ginned cotton, in comparison with the production for last season of 12,940,962 lb. and 7,819 bales respectively.

449. *Cotton Prospects.* (*Crops and Markets*, viii., **8**, 1930, p. 172.) "According to the report of the Senior Cotton Grader, Durban, the general condition of the crops at the end of April was good. In the districts of Weenen and Richmond, and in the Umkomaas Valley area, in Natal, however, the condition was poor to fair owing to bollworm infestation. In the Rustenburg district in the Transvaal the late rains caused some discoloration, and the continuous rains in February and March resulted in boll-rot in the cotton in the Northern Transvaal. Yields of late cotton in the Orange River area will be affected by early frosts which have fallen. The crop is moving rapidly and early."

450. *The Futility of the One-Crop System.* By E. N. T. Powell. (*Farming in S. Afr.*, v., **50**, 1930, p. 64.) Deals with the evils of the one-crop system, and points out the advantages of a mixed method of farming with cotton as the chief money crop, and subsidiary crops, such as maize, kaffir corn, tobacco, beans, peanuts, etc. The author concludes by saying: "The cotton industry in the Union is going to stay, as shown by statistics of growth year by year. The cotton planter has his Department of Agriculture and the Empire Cotton Growing Corporation at his back. Research is being carried out in all directions, results of which are always obtainable, especially through the Department's publication *Farming in S. Africa*. It remains for the farmer to take the advice held out to him from these reliable sources."

[*Cf.* Abstr. **495** and **604**.]

451. SUDAN: *Cotton Cultivation*—1930-31 *Season's Prospects.* (*Monthly Rpt. Coml. Intell. Branch, Cent. Econ. Board, Sudan Govt.*, xxiv., **6**, 1930, p. 204.) The following are the latest reports from the various districts: In Talodi the young cotton crop has now established itself, despite a slow start owing to poor rainfall. All new works and preparations for the flood in the Gash Delta are practically complete. In Tokar the percentage of first-class cotton has kept up well, but there is a scarcity of cotton pickers. A distinct keenness is apparent in most cultivators of cotton in the Latuka district, and for the first time the crops will be sown without organized help from the district police.

452. TANGANYIKA. *Crop Prospects.* The latest report received is to the effect that in the Rufiji District the late cotton promises to be a good crop. The crop is short in Morogoro and Kilosa. In the Lake Victoria area, cotton in Shinyanga District has been damaged by rain, but in the other districts the crop is good.

453. *Cotton Production Figures : A Comparison between* **1929** *and* **1928.** We are indebted to H.M. Eastern African Dependencies Trade and Information Office for the following figures, which unfortunately arrived too late for inclusion in Mr. Kirby's article on the "Progress of Cotton Growing in Tanganyika Territory" (p. 172 of this Review):

"The following was the production of cotton in the Territory in the 1929 season, according to the ginnery returns; the 1928 figures are given for comparison. The lower yields of 1929 are to be attributed to a much drier season.

Province.	400 *Lb. Bales.*		
	1928.	1929.	1930 (*estimated*).
Eastern	18,767	17,456	12,500
Tabora	1,197	245	500
Mwanza	11,056	7,532	8,500
Lindi	1,314	1,962	1,000
Tanga	267	318	200
Northern	263	177	13
Bukoba	90	95	100
Total	32,954	27,785	22,813"

454. UGANDA. *Cotton Experiments.* (*Bull. Imp. Inst.*, xxviii., 2. 1930, p. 208.) A summary is given of the bulk increase work with cotton during the half-year ended December 31, 1929. Germination of the crop was poor, it being necessary to fill some blanks as many as three times. A low yield is anticipated—not more than from 200 to 250 lb. per acre—chiefly due to the development of "blackarm" and rather bad attacks from the "no fixed abode" type of white ants. Apart from the usual insect pests, such as bollworms, jassids, stainers, etc., one new insect was discovered on cotton which was reported to be a member of the *Lasiocampidæ*. It was found on one plant only, and cannot at the moment be considered a pest of the crop.

455. WEST INDIES. *Cotton Reports.* (*Trop. Agriculture*, vii., 6, 1930, p. 160.)

Montserrat.—The area prepared for cotton this year was the largest on record. Germination of the crop has been excellent, but the plants are suffering from want of rain.

Nevis.—The yield of cotton will be much less than was expected on account of severe attacks of cotton worm. Frequent rains in the early part of the year, and a sudden change to dry weather conditions caused the shedding of a fairly large percentage of the younger bolls. The pink bollworm has not yet made its appearance, but the cotton stainer is more plentiful this season than it has been for some time past.

St. Kitts (*W. I. Comm. Circ.*, xlv., 827, 1930, p. 250.) The cotton crop for 1929 amounted to 327,299 lb. lint from 1,400 acres, a yield of over 230 lb. lint per acre, this being the highest yield for many years. There was very little damage to the crop by either the cotton-leaf worm or the pink bollworm.

456. COTTON IN MONTSERRAT. (*Rpt. of Agr. Dept.*, 1927-29.) Increasing amounts of pedigree seed are being distributed. At the Grove Experiment Station cotton breeding and selection work has been continued on the lines of the Vilmorin system of pedigree selection followed since 1908. The Heaton strain is showing a steady improvement. Early methods of cleaning up cotton fields, and early planting, coupled with strict observance of the close season, have been successful in controlling pink bollworm.

457. *Cotton Experiments.* (*Bull. Imp. Inst.*, xxviii., 2, 1930, p. 205.) Mr. C. A. Gomez reports that during the half-year ending December, 1929, investigational work in the breeding for high lint index, high boll loculi, and freedom from nep

in Sea Island cotton strains was continued. Experiments to further induce early maturing of cotton were started. The incising of the involucres of cotton flowers at the time of anthesis, in order to force earlier maturity of cotton bolls, was performed on many plants in progeny rows, but nothing definite can yet be published.

458. St. Vincent. *Cotton Industry.* A report recently received from the Agricultural Superintendent, on the cotton crop for the quarter ended June 30, is as follows: " By the end of June all plants of Sea Island cotton were destroyed. Towards the end of the quarter the number of cotton stainers increased, but not to any abnormal extent. The attacks of pink bollworm were very light; secondary growth of cotton was badly attacked by leaf blister mite. The changing of the planting season has been a success, and has resulted in the production of cleaner and brighter cotton. Exact returns are not yet available, but the yield for the Colony should be from 120 to 130 lb. of lint to the acre, a total of between 216,000 and 234,000 lb."

459. Agriculture in St. Vincent. (*West Ind. Comm. Circ.*, xlv., 829, 1930, p. 277.) It is stated that " the quality of St. Vincent cotton—once the finest in the world—has shown signs of deterioration. Much is expected, however, from a change round in seasons, which was at first viewed with suspicion by the peasants, and the reopening of the Cotton Research Station by the Empire Cotton Growing Corporation, who have appointed Mr. S. H. Evelyn, a former Diploma student at the Imperial College, to take charge of it—a welcome and generous gesture."

460. Sea Island Cotton. By J. A. Todd. (*Trop. Agriculture*, vii., 7, 1930, p. 190.) Since the collapse of the Sea Island crop of the U.S., the West Indies have had a monopoly of this variety. The industry, however, has been in a depressed condition for several years, but during the last year or two there have been signs of revival. The matter is largely a question of price, and the better yields of some of the new Heaton varieties will help to cheapen it. The author states that quite recently there has been some reaction against artificial silk for hosiery, which has caused an increased demand for fine cottons; it is essential, however, if Sea Island is to be used for this purpose, that it should not be much more expensive than the best Egyptian cotton.

COTTON IN EGYPT.

461. A Brief Account of the Research Work of the Sections of the Ministry (of Agriculture) at Giza. (Govt. Press, Cairo, 1929.) This account was drawn up on the occasion of the visit of H.M. King Fouad I. to these sections in April, 1929. The Cotton Research Board was first formed in 1919 to co-ordinate and direct all researches on cotton. In course of time its functions have changed, as the various sections concerned acquired experience, together with an increasing amount of work on crops other than cotton. The Board itself has recently been reconstituted to serve as a means of liaison between the various administrations who are affected by cotton problems, and a Committee of the Board is investigating the problems presented by the cultivation of cotton in the basin lands of Upper Egypt, its relation to irrigation conversion projects, water-supply, soil fertility, co-operation, and the value of the new types of cotton which have been introduced in that district. The Botanical Section deals with the breeding of cotton, including the working and constant visiting of chequer plot testing sites in many parts of Egypt. This section is also concerned with the production of pure seed. The Plant Protection Section has three divisions: Entomological Research, Mycological Research, Applied Entomology. The Chemical Section investigates

soils and manures, etc., and there is also a Horticultural Section. Nine experiment stations in all are kept up.

462. De la Purification et de l'Amelioration des Variétés de Cotons Egyptiens par la Société Royale d'Agriculture du Caire. By W. J. Lugard. (Extrait du *Bull. Agr. du Congo Belge*, 1930.) A description of the work dealing with pure lines; determination of quantitative and qualitative characters; germination; number of flowers; shape of the boll; height; number of vegetative branches; shape of the leaf; number of bolls; laboratory experiments, etc.

463. Cotton Prospects. (*Int. Rev. Agr.*, Rome, xxi., 6, 1930, p. 252.) After an initial check to growth, the cotton crop was favoured by settled weather, and in June the condition of the crop was promising. Attacks of locusts have been successfully dealt with and confined within limits.

464. Why Cotton Acreage should not be Restricted. By A. M. Psalti. (*Egyptian Gazette*, June, 1930.) There are many factors involved, and the author enumerates and explains some of these under the following headings: Egypt's Crop in Relation to World Crops; Agricultural Aspects; Repeal the Cotton Tax.

COTTON IN THE UNITED STATES.

465. Cotton Production and Distribution: Season of 1928-29. By H. J. Zimmerman. (*Bull.* 166, *U.S. Dept. of Comm.*, Washington, D.C., 1929.) This bulletin summarizes, for the past season, the reports of cotton ginned from the crop of 1928 to twelve specified dates during the ginning period, and the monthly reports of the following: Cotton consumed, imported, exported, and on hand; the number of cotton-spinning spindles and active spindle hours; cotton seed received, crushed, and held at the oil mills; and cotton-seed products, including refined cotton oil, manufactured, shipped out, and on hand.

The report also deals, under the following headings, with: (1) Supply and distribution of cotton in the United States; (2) annual production of cotton and linters in the United States as returned by ginners and delinters, distributed by states, from 1925-28 inclusive, with production for previous years; (3) consumption and stocks of cotton, and number of cotton spindles and active spindle hours in the United States for the year ending July 31, 1929, together with detailed statistics of spindles, cotton consumed, and cotton on hand, including comparative figures for previous years; (4) imports and exports of cotton for the year ending July 31, 1929, with comparative figures for previous years; (5) world's production, consumption, and stocks of cotton, and number of cotton spindles by countries, for the season of 1928-29; and (6) cotton seed received, crushed, and on hand, and products manufactured, shipped out, and on hand for the year ending July 31, 1929, with comparative data for earlier years.

466. Cotton Predictions, United States. (*Science*, Supplt., lxxi., 1848, 1930, p. x.) Fickle weather and the boll-weevil have been made to tell as early as September 1 almost exactly how much cotton will be harvested in the United States during the following fall months. Just how these predictions can be made, based on the weather reports from hundreds of stations throughout the cotton belt, was made public for the first time by J. B. Kincer, chief of the Division of Agricultural Meteorology of the U.S. Weather Bureau, at the recent meeting of the American Meteorological Society.

The method which Mr. Kincer and his associates, W. A. Mattice and Miss G. B. Diehl, have worked out during the past two years will give cotton-growers, buyers, and investors accurate information on production far in advance of the harvest,

and should enable them to sell and buy more profitably. Calculations have been made of estimated and actual production since 1909 with an accuracy of approximately 97 per cent.

For the bumper crop year of 1926 the actual production was almost exactly the same as the predicted. In 1921, the year of smallest yield, an error of 7 per cent., the largest of the 20-year period, was made. For 1928 the prediction was only 3 per cent. less than the actual production.

To make the calculations, Mr. Kincer uses weather information, such as amount of rainfall, number of rainy days, relative humidity, amount of sunshine, and average highest and lowest temperatures. Weevil damage is estimated from the weather of the preceding summer, which determines the number of insects that hibernate during the winter; from the severity of the winter, because many might be killed by the cold; and from growing season weather, as dry weather keeps the weevil in check, and damp weather greatly increases his family.

From this information a weevil index is worked out by mathematical relations to be combined with the weather-yield relation for the final result. The predictions can be made for each state as well as for the entire cotton belt.

This is the first study of cotton prediction for the cotton belt as a whole made on combined weather and weevil effects. Details of the method are to be published in technical journals.

467. AMERICAN COTTON: QUALITY. By A. F. Johnson. (*Text. World*, **77**, 1930, p. 2947. Abstr. from *Summ. of Curr. Lit.*, x., **12**, 1930, p. 292.) The deterioration of American cotton is discussed, and it is pointed out that the farmer has difficulty in disposing of $\frac{7}{8}$ in. and shorter cotton, while the spinner has difficulty in obtaining $\frac{15}{16}$ in. to $1\frac{1}{16}$ in. cotton of uniform staple. About 14·3 per cent. of the 1928 and 20·1 per cent. of the 1929 crop was $\frac{13}{16}$ in. or shorter. Of the 1929 crop, there is left, after deducting the untenderable, only 10,994,800 bales of tenderable cotton, or only 75·7 per cent. of the total. Of these bales 5,212,400, or 35·9 per cent. of the tenderable cotton, is $\frac{7}{8}$ in. in staple, leaving only 5,782,400 bales of $\frac{15}{16}$ in. and longer staple, which is generally referred to as "character cotton." It is suggested that the mills could help the farmers by aiding the distribution of better varieties of seed, by paying a suitable premium for the longer staple cotton, by assisting in the working out of improved ginning methods, and by bringing about a change in the regulations governing the cotton exchanges so that $\frac{15}{16}$ in. staple will be the basis of buying or selling cotton, instead of $\frac{7}{8}$ in. staple.

468. WESTERN AMERICAN COTTON: IMMATURITY. (*Cotton*, U.S., **94**, 1930, p. 810. Abstr. from *Summ. of Curr. Lit.*, x., **13**, 1930, p. 432.) A case of fuzz on sheetings is ascribed to the use of Western cotton. This cotton contains large percentages of immature and of short fibres, caused by the cotton being gathered before the bolls open or after the bolls have been exposed to frost. To reduce the trouble modifications in sizing formulæ and in the adjustment of looms and cards are suggested.

469. ROUND BALES PREFERRED FOR AMERICAN COTTON. (*Cotton*, M/c., xxxvi., **1726**, 1930, p. 4.) Widespread adoption of the round bale for packing and shipping cotton and the establishment of tare standards as a pre-requisite in net-weight trading in the staple, were advocated recently by Arthur W. Palmer, chief of the Cotton Marketing Division, U.S. Dept. of Agriculture, states the *Textile World*. It was pointed out that since the round bale press, which prior to April 1 had been available only on licence for use, is now offered for sale, more attention will undoubtedly be given to the round package. Inadequate protection of contents, lack of uniformity of weight of contents, lack of uniformity in weight of tare, difficulty in handling, and greater danger from fire hazards, were cited as dis-

advantages of the square bale. Mr. Palmer stated that hesitation on the part of cotton traders to approve the net weight principle unless coupled with some measure disclosing the actual tare on any bale at any time is understandable. Establishment of tare standards is a possibility.

470. AMERICAN COTTON INDUSTRY: STANDARDIZATION OF RUNNING TIME. (*Cotton*, U.S., **94**, 1930, p. 760. Abstr. from *Summ. of Curr. Lit.*, x., **13**, 1930, p. 355). A policy of maximum operation for cotton mills of 55 hours day run and 50 hours night run per week, with no machinery operating at noon and no other overtime, is being recommended to the American cotton industry as a means of assuring greater uniformity of running time and regularity of employment. The policy has the approval of more than 60 per cent. of the spinning mills and of a considerable proportion of the weaving mills.

471 U.S. PER CAPITA CONSUMPTION OF COTTON CLOTH. (*Int. Cot. Bull.*, viii., **32**, 1930, p. 743.) Statistics show that the per capita consumption of cotton cloth in the U.S.A. has increased from 57 square yards in 1899 to an average of 68 square yards for the past seven years.

472. THE FEDERAL FARM BOARD. By H. G. Safford. (*Int. Cot. Bull.*, viii., **32**, 1930, p. 638.) An interesting lecture by Mr. H. G. Safford, President of the American Cotton Shippers' Association, criticizing the great changes in cotton policy indicated by the appointment of the Federal Farm Board, the American Cotton Co-operative Association, and the Cotton Stabilization Corporation.

473. CURRENT FARM ECONOMICS, OKLAHOMA. (*Circ. Oklahoma Agr. Exp. Sta.*, Ser. 49, vol. iii., No. 1, 1930.) *Grade and Staple of Oklahoma Cotton.*—The final Grade and Staple Estimates Reports compiled by the Cotton Division of the U.S. Dept. of Agriculture in co-operation with the Dept. of Agricultural Economics, Oklahoma, shows that of the cotton produced in Oklahoma during the 1929-30 season only 63 per cent. was tenderable on a Section 5 Future contract, while 416,000 bales, or 37 per cent., were untenderable, due mostly to short staple.

The following table, taken from the Grade and Staple Estimates Report, shows the percentage distribution of each staple length.

AMERICAN UPLAND PRODUCED IN OKLAHOMA, 1929-30.

Staple Length.	*Bales.*	*Per Cent.*
Total	1,125,000	100·0
$\frac{13}{16}$ and under	321,300	28·6
$\frac{7}{8}$	500,000	44·4
$\frac{15}{16}$	207,800	18·5
1 and $1\frac{1}{32}$	67,100	6·0
$1\frac{1}{16}$ and $1\frac{3}{32}$	22,600	2·0
$1\frac{1}{8}$ and $1\frac{5}{32}$	6,200	0·5

The increased amount of short staple cotton produced this past season was due partly to the fact that the season was exceptionally dry, and partly to the fact that farmers have been planting increased amounts of varieties which produce an inferior staple. Under a marketing system which does not pay a premium for good staple such a result is inevitable. No farmer is willing to go to the extra expense and trouble of producing high quality cotton if it does not pay him to do so.

474. TYPES OF FARMING IN OKLAHOMA. By J. O. Ellsworth and F. F. Elliott. (*Exp. Sta. Bull. No.* 181, Oklahoma, 1929.) **The highest percentage of crop area devoted to cotton was 70 per cent., and many counties had over 50 per cent.**

The general result of the investigation seems to point to the larger farms as the more economic and profitable.

475. INVESTIGATIONS IN AGRICULTURAL ECONOMICS AT THE SOUTH CAROLINA STATION, 1928-29. (*S. Car. Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, 62, 7, 1930, p. 676.) *Farm Organization and Management in the Piedmont Area.*—The most successful farms had 50 per cent. of their crop land in cotton, and the least successful 42 per cent. The best farmers realized about 12 per cent. on their investments, while the poorest showed a loss of 1 per cent. The cost per pound of producing cotton increased from 12·5 cts. on the farms averaging from 351 to 450 lb. per acre, to 20·9 cts. on those producing only from 100 to 200 lb.

Cotton Marketing Study.—The grade and staple study indicated that of the 1928 South Carolina crop, 63·03 per cent. was $\frac{7}{8}$ in. or less, and 36·97 per cent. was $\frac{15}{16}$ in. or longer staple, and that 32·56 per cent. was middling grade, 40·87 per cent. above middling, and 26·57 per cent. below middling.

476. FERTILIZER TESTS IN GEORGIA. (*Ga. Coastal Plain Sta. Bull.* 11, 1929. Abstr. from *Exp. Sta. Rec.*, 62, 8, 1930, p. 728.) Fertilizer tests with cotton showed that a 9-3-5 formula was a most efficient combination on the various phases of Tifton sandy loam soils, with slightly more nitrogen and potassium on poor, run-down, black pebble soils. On good soils, with proper management, from 800-1000 lb. fertilizer may be used profitably. In a complete fertilizer, quickly available inorganic carriers of nitrogen, as sodium nitrate or ammonium sulphate, gave much better results than organics. Potassium in the form of kainite gave better yields than from other sources. Results during five years indicated that from 100-125 lb. sodium nitrate, or its equivalent in a similar fertilizer, applied just before squaring, may be used profitably. Substantial increases in yields of cotton resulted from green manuring and use of complete fertilizer, but no benefits came from liming.

477. COTTON VARIETY EXPERIMENTS AT SUBSTATION NO. 2, TROUP. By W. S. Hotchkiss and P. R. Johnson. (*Bull. No.* 406. *Texas Agr. Exp. Sta.*, 1930.) Two hundred and five varieties and strains of cotton were tested during the sixteen years 1913-1928 inclusive. Half and Half gave the highest yield, with an average of 300 lb. lint per acre; New Boykin, Kasch, Mebane 804, and Harper ranking next in order with yields of 258, 257, 255, and 252 lb. of lint per acre respectively. Half and Half produced the shortest lint ($\frac{3}{4}$ in.), but ranked first in lint percentage with 41·9 per cent., followed by Harper with 39·3 and Kasch with 39·0 per cent. Bennett's Lone Star produced the largest bolls, 55 making one pound of seed cotton; the bolls of Lankart, Kasch, Lone Star, Mebane, Rowden, and Harper averaged 56 to 62 per pound of seed cotton. The bolls of these varieties were storm-resistant, yet were easy to pick.

Half and Half was the most profitable variety grown, having an acre value on the local market of $47.60 as compared with $41.08 for New Boykin, $40.87 for Kasch, $40.65 for Mebane 804, and $40.06 for Harper. Based on the central market prices, however, on which market premiums are paid for staple cotton, there was no significant difference in the money value per acre on Half and Half, New Boykin, and Kasch, the acre values being $46.31, $45.96, and $45.73.

478. RESULTS OF COTTON VARIETY TESTS 1926-1929. By H. B. Tisdale and J. T. Williamson. (*Alab. Sta. Circ.*, 55, 1930. Abstr. from *Exp. Sta. Rec.*, 62, 8. 1930, p. 732.) Varietal trials with cotton during the period indicated showed D. and P.L. 4-8, Cook 1010 (Williamson), Delfos, Trice, and Cook 1627 to lead in order of yields in North Alabama (14 tests), and D. and P.L. 4-8, Dixie Triumph, Cook 1627, Cook 588, and Cleveland (Piedmont) in Central Alabama (9 tests). In comparisons of wilt resistant varieties in Central and South Alabama (19 tests),

Cook 307 (Rhyne), Dixie-Triumph, Toole (Council), Lewis 63, and Cook 307 (Bridges) led during the years 1926-29.

479. Cotton Varieties for Louisiana. By H. B. Brown. (*La. Bull. No.* **207**, 1930.) Tests during the past three years have indicated that Wilson Cleveland, D. and P.L. No. 4-8, Dixie-Triumph, Stoneville No. 2, Delfos, D. and P.L. No. 6, and Express 317 are generally the most paying cottons to plant.

480. California. *Cotton Cultivation.* (*S. California Crops*, vi., **6**, 1930, p. 6.) Estimates show a reduction of about 15 per cent. in cotton acreage over last year's record planting, but all factors point to production equalling that of 1929.

481. Important Factors in Cotton Growing in North Carolina. By P. H. Kime. (*N. Carolina Sta. Agr. Inform. Circ.* 46, 1930. Abstr. from *Exp. Sta. Rec.*, 62, **8**, 1930, p. 732.) Important factors in the economical production of cotton discussed include soils, preparation, planting, varieties, spacing, cultivation, picking and storage, ginning, and care of seed for planting.

482. Cotton Mill Conditions in the South of U.S.A. By R. C. Dexter. (*Int. Cot. Bull.*, viii., **32**, 1930, p. 731.) From this report we learn that the labour supply in practically all the textile mills is drawn from two classes of people, the tenant farmer in the Piedmont area and the mountaineer from the foothills of the Appalachians. Life in the mills has on the whole an elevating effect upon the workers, whose home conditions are in many cases very bad indeed. Cash wages are lower in the south than in the north by about $4-5 a week. Hours are from 55 to 60, against 48 in Massachusetts.

[*Cf.* Abstr. **493, 496-9, 556-561, 605, 606.**]

COTTON IN FOREIGN COUNTRIES.

483. Association Cotonnière Coloniale. We have received a copy of *Bulletin No.* 91, 1930, containing accounts of cotton cultivation during 1929 in Senegal, Sudan, Haute-Volta, Dahomey, Ivory Coast, etc., and also an article by Youssef Nahas Bey on the efforts made by Egypt to maintain her leading position in cotton production.

484. Brazil. Reports from the Statistical Service in the State of Parahyba for February and March may be briefly quoted as giving an indication of the direction of trade. Smoothing the figures, out of 2,000,000 kilos of lint exported from the port of Cabedello, 900,000 went to Liverpool, 600,000 to other Brazilian ports, the rest to the Continent; 49,000 kilos of linters went to Liverpool; 400,000 kilos of cotton-seed oil went to Hamburg, and 273,000 to Liverpool; 900,000 kilos of cake to Liverpool and Hamburg, and over 2,000,000 kilos of seed to Liverpool.

485. China. *Cotton Spindles and Looms in Shanghai and other Ports of China in* 1930. (*Cotton M/c.* xxxvi., **1726**, 1930, p. 2.) The present number of spindles is reported to be 4,130,236, with 100,000 in course of construction. Looms are given at 28,772, with 500 in course of construction. The output of the mills is from 800,000 to 1,000,000 bales of yarn, according to the demand. Calculating that each loom works twelve hours a day, it should produce 72 yards of cloth of the quality 50 picks to the inch. Reckoning this at 70 yards ×28,772 looms ×300 days, gives a yearly total of 604,212,000 yards, or 15,105,400 pieces of 40 yards length.

486. Japanese Cotton Industry. By J. Kerfoot. (*Text. Weekly*, **5**, 1930, pp. 299 and 305. Abstr. from *Summ. of Curr. Lit.*, x., **14**, 1930, p. 386.) Describes the organization of the Japanese cotton industry. The author states that the

industry has made rapid strides in the medium count trades, but is perturbed by the fact that to-day there is an adverse balance of yen 180,000,000 between the cost of imports and the sum realized on the exports of cotton goods.

487. MEXICO. *Cotton Textiles.* (*Text. Rec.*, xlviii., **567**, 1930, p. 78.) Señor J. Rivero Quijano (former President of Industries of Mexico), at a recent meeting of the National Association of Cotton Manufacturers in Boston, stated that while the textile industries of his country were neither large nor prosperous, they could expect a brighter future from the betterment of conditions the Government is actively encouraging. There is ample scope for expansion, seeing that according to Señor Quijano the 15,000,000 inhabitants of Mexico "have the very low clothing index of 4·50 dols. per capita per year."

488. RUSSIAN COTTON INDUSTRY. (*Int. Cot. Bull.*, viii., **32**, 1930, p. 736.) The output of finished cotton goods for 1928-29 amounted to 2,952,000,000 metres, an increase of 15 per cent. on the 1927-28 output. The output of cotton yarn was 350,000 tons, or a gain of 12 per cent. on the previous year.

489. TURKEY. We have received from the Dept. of Overseas Trade a copy of the report on the *Economic Conditions in Turkey, to April*, 1930 (H. Woods), from which we quote the following: "The cotton industry is undeveloped. The leading factories do not possess over 80,000 spindles between them, and the total capacity of the looms in the country, in factory and homestead, is not sufficient for the requirements of the country in thread and tissues. For some years, therefore, Turkey will be dependent on foreign manufacturers for a good portion of her supply; but it should be borne in mind that Turkey produces some 20,000 to 22,000 tons of cotton, of which her present factories only consume a small portion."

SOILS AND MANURES.

490. THE IMPERIAL SOIL BUREAU. By Sir John Russell. (*J. of the Min. of Agr.*, London, 1930, xxxvi., **10**, p. 925. Abstr. from *Int. Rev. of Agr.*, xxi., **2**, 1930, p. 49.) Describes the activities and projects of the new Soil Bureau attached to Rothamsted Experimental Station under the direction of Sir John Russell.

491. A COMPARISON OF FIELD METHODS OF DETERMINING SOIL REACTION. By A. B. Beaumont and C. H. Thayer. (*Jour. of Amer. Soc. of Agr.*, xxi., **11**, 1929, p. 1102, Geneva, New York. Abstr. from *Int. Rev. of Agr.*, Rome, xxi., **3**, 1930, p. 94.) Two workers carried out independent tests of twenty different soils in Massachusetts, using six of the well-known colorimetric methods of determining soil reaction. The results showed that the values given by the methods tested may deviate considerably from those of the potentiometer, and depend to a large extent on the individual observer. Colorimetric methods must be regarded as giving results of varying approximation to the more reliable electric methods.

492. SOILS AND FERTILIZERS. By E. M. Crowther. (Reprinted from the *Rpts. of the Progress of App. Chem.*, xiv., 1929.) A review of recent progress in the study of these subjects, with references to the literature, which should prove of great use to all concerned.

493. FERTILIZER INVESTIGATIONS. (*U.S. Dpt. of Agr. Rpt. of the Chief of Bur. of Chem. and Soils*, June 30, 1929, Washington, D.C. Abstr. from *Int. Rev. of Agr.*, Rome, xxi., **1**, 1930, p. 95.) The Bureau has carried out a series of investigations with regard to the fertility and fertilizer requirements of the principal soil types, nitrogen fixation by free-living and symbiotic bacteria, industrial nitrogen fixation and the transformation of the synthetic products obtained, the rational utilization of inorganic phosphates and the recuperation of fluorine in

the manufacture of superphosphates, the rational utilization of all minerals yielding potassic fertilizers in order to reduce the import of potash salts from Europe (costing annually about 18 million dollars), the manufacture of concentrated fertilizers (also in order to reduce imports), methods of preventing the deterioration of fertilizer sacks, etc.

494. POTASH EXPERIMENT. (*S. Carolina Sta. Rpt.*, 1929. Abstr. from *Exp. Sta. Rec.*, 62, 7, 1930, p. 614.) Potash fertilizer tests with cotton on a light soil very low in available potash showed large increases in yield from the application of 50 lb. potassium chloride to the acre.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

495. EARLY MATURITY IN COTTON. By S. R. de Villiers. (*Farming in S. Afr.*, June, 1930, p. 136.) In the Middle-veld area the growing season for cotton is frequently much shortened by delay in planting due to lateness of rains, and under such conditions early maturity in cotton is much to be desired. In this article Mr. de Villiers gives an abstract of his analysis of the factors affecting early maturity, such as germination period, rate of growth, height of first sympodium, spacing and time of thinning, shedding, etc.

496. A STUDY OF THE MECHANICAL HARVESTING OF COTTON. (*42nd Ann. Rpt.*, 1929, *Tex. Agr. Exp. Sta.*, p. 63.) This study was conducted at College Station, Brazos County, Texas. Three types of harvesters were used—the McCormick-Deering stripper, the modified finger-type stripper, and the single slot-type stripper. Late in the season some salvage stripping was done with a John Deere machine, but this arrived too late to be compared with other machines. This is a new type of machine using spiked metal rolls which revolve in opposite directions in stripping the bolls from the plants. The cotton was not harvested until all of the bolls on the plants had opened, although at that time not all of the leaves had shed. The McCormick-Deering stripper was the most efficient of the machines; it harvested the equivalent of 560 lb. of picked cotton an hour in cotton yielding one-half bale per acre on upland soil. The machine-picked cotton was lower in grade than that picked by hand, owing to the presence of small amounts of leaf and boll trash which the cleaning equipment of the gin was unable to remove completely from the seed cotton.

As a result of the year's experience an experimental machine is being constructed that will harvest cotton successfully while the leaves on the plant are still green. The experimental machine will be equipped with revolving smooth rubber rolls.

497. COTTON GINNING. (*Int. Cot. Bull.*, viii., 32, 1930, p. 634.) A device has recently been placed on the market in the United States which dries out any damp or green seed cotton before being fed to the gin. Cotton is fed into the drier from the wagon with the usual air suction through an unloader. The drying tube is 40 ft. long and about 5 ft. in diameter. This tube revolves slowly. Heated air from an oil or gas burning furnace is forced through the tube by a fan. The tube is equipped with shelves. As the tube revolves the wet cotton is simply carried to the top on the shelves. It naturally drops off and falls through the hot-air stream.

Regardless of the moisture content of the seed cotton fed into this machine, it will automatically discharge uniformly dry cotton at the discharge end. The drying tube is higher at the discharge end, and the hot-air stream is regulated so that dry cotton is carried uphill toward the discharge end, while wet cotton remains in the machine until dry. Cotton will not discharge from the tube until it is of the same specific gravity as dry cotton.

498. Ginning of Cotton in Relation to the Market and Spinning Value of the Lint. (*42nd Ann. Rpt.*, 1929, *Tex. Agr. Exp. Sta.*, p. 62.) During 1928 three commercial staple lengths of cotton—viz., 1 in., 1⅛ in., and 1¼ in.—were ginned under different conditions, including saw speeds of 640, 760, and 840 r.p.m.; a loose, medium, and tight breast-roll setting for each saw speed was used. The market value of the lint was lowered when the cotton was ginned with a tight breast-roll, particularly in the case of the longer staples, which were badly gin-cut in some instances.

499. Cotton Ginning Experiments. (*Int. Cot. Bull.*, viii., **32**, 1930, p. 637.) Advices to hand state that President Hoover has asked an appropriation of $100,000 to carry out the provisions of the law signed on April 21 to establish an experimental cotton-ginning laboratory. According to experts of the Government, the damage to the American crop due to improper and antiquated machinery is upwards of $50,000,000 a year.

500. Cotton-Seed Meal for Maintaining, Growing, and Fattening Hogs. (*Texas Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, 62, **7**, 1930, p. 660.) The results indicate that not more than 9 per cent. of cotton-seed meal should be included in the ration of growing and fattening swine. Pigs receiving 12 per cent. were not so thrifty, and did not gain so uniformly as those receiving 9 per cent. of the meal.

501. Cotton-Seed Meal with Various Roughages as Fattening Rations for Lambs. By R. F. Cox. (*New Mexico Sta. Bull.* 179, 1929. Abstr. from *Exp. Sta. Rec.*, 62, **8**, 1930, p. 761.) In this study lambs were fed as much as 1 lb. of cotton-seed meal per head daily for periods of from 90 to 100 days without serious loss due to poisoning or malnutrition, especially when roughages other than cotton-seed hulls were fed.

502. The Digestibility of Cotton-Seed Meal as a Supplemental Feed for Range Cattle in New Mexico. By W. E. Watkins. (*New Mexico Sta. Bull.* 178, 1929. Abstr. from *Exp. Sta. Rec.*, 62, **8**, 1930, p. 760.) It was determined that a larger percentage of nutrients was digested when the nutritive ratio ranged from 1:2·8 to 1:6·1, as was the case when cotton-seed meal was fed with wheat straw, than when the nutritive ration was 1:18, when wheat straw was fed alone.

[*Cf.* Abstr. **450** and **469**.]

DISEASES, PESTS, AND INJURIES.

503. The Biological Control of Insect and Plant Pests. By W. R. Thompson. (*E.M.B.*, June 29, 1930. Pubd. by H.M. Stat. Off., price 1s. net.) This report contains a general account of the work on Biological Control carried on at Farnham House Laboratory, which, having regard to its field of activity, resources, and programme, can fairly claim to be the most important centre for work of this type now existing in the Empire. Since it is the first published report, it has been designed with the object of giving a comprehensive idea of the policy, organization, resources, and practical efforts of the laboratory. The second part is devoted to a general account of the problems encountered in operations in biological control, with special reference to the organization and conduct of practical work. A certain number of purely theoretical considerations have been included because of their value in indicating lines of research in the laboratory and in the field; but the great majority of the statements and suggestions are the fruit of some twenty years' experience in work in this field, and have been repeatedly tested in practice. An attempt has been made to arrange them so that they constitute, as it were, a rough sketch of the technique of this

branch of economic entomology. So far as the writer is aware, no account of this kind has yet been published.

The third part of the report deals with the history, organization, and equipment of the laboratory, in order to show what resources it possesses to cope with the problems encountered in practical work. The fourth part gives a summary of the results obtained up to the present date, together with a list of the projects which have been submitted to the laboratory. A bibliography, including the papers most useful to workers in this field, has been appended.

The foundation of the laboratory was made possible by grants from the Empire Marketing Board, and the officials of the Board have proved most helpful and sympathetic in every way.

504. SOME ASPECTS OF THE MORBID ANATOMY OF PLANTS. By Dr. E. J. Butler. (*Anns. of App. Biol.*, xvii., **2**, 1930, p . 175.) The anatomical modifications in the tissues of plants caused by the action of gall-inducing fungi and insects are illustrated by a number of examples, and compared with those produced by various processes of regeneration and wound healing or by factors that lead to anatomical changes without the intervention of wounds, such as nutrition, humidity, and the like. It is concluded that all living cells have the potentiality to react to various stimuli by hypertrophy, hyperplasy, or the development of meristematic tissues, and that the pre-existing meristems are not, of necessity, primarily implicated in gall formation.

505. ENTOMOPHAGOUS PARASITES AND PHAGOCYTES. By W. R. Thompson. (*Nature*, cxxv., **3144**, p. 167, 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **5**, 1930, p. 230.) The author states that as a general rule the healthy larvæ of entomophagous insects are not surrounded by phagocytes, provided that they lie free within the body cavity of the host. If a parasite has an anatomical relation with the host of such a nature that destruction of the tissue is produced, a considerable accumulation of phagocytes may occur round the point of lesion. The extent to which phagocytes accumulate is variable, and appears to depend in part upon the specific nature of the host, and in part upon its general condition, but such an accumulation appears to have no effect on healthy parasites.

506. A GENERAL TEXTBOOK OF ENTOMOLOGY. By A. D. Imms. (Methuen and Co., Ltd., London. 2nd ed. revised, 1930. Price 36s. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **5**, 1930, p. 225.) This second edition contains various additions and emendations, the most important being revised classifications of the orders Dermaptera, Isoptera, and Thysanoptera, additions to the bibliographies at the end of many of the chapters, and notes on recent advances on the subject in the form of addenda.

507. REPORT ON INSECTICIDES AND FUNGICIDES. By J. J. T. Graham. (*Jour. Assoc. Official Agr. Chemists*, xii., **2**, 1929, Washington, D.C. Abstr. from *Rev. App. Mycol.*, ix., **4**, 1930, p. 258.) Very satisfactory results are stated to have been obtained by the tentative electrolytic method for the determination of copper in such products as Bordeaux-Paris green and Bordeaux-calcium arsenate. The method (technical details of which are given) provides for the deposition of copper from nitric acid solution without the previous removal of arsenic, the latter being oxidized to the pentavalent condition and maintained in this state during the electrolysis by hydrogen peroxide. It is recommended that this method (the results of which agree with those obtained by the thiosulphate method) be definitely adopted by the Association of Official Agricultural Chemists.

508. EXPERIMENTELLE UNTERSUCHUNGEN UBER DIE WIRKUNG DER UMWELTFAKTOREN AUF INSEKTEN. I. DIE MASSENVERMEHRUNG DER BAUMWOLLEULE PRODENIA LITTORALIS IN AEGYPTEN. (EXPERIMENTAL INVESTIGATIONS ON THE

EFFECTS OF ENVIRONMENTAL FACTORS ON INSECTS. I. THE OUTBREAKS OF P. LITURA IN EGYPT.) By E. Janisch. (*Z. Morph. Oekol. Tiere*, xvii., 1-2, p. 339. Berlin, 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, 5, 1930, p. 241.) The outbreaks of *Prodenia litura*, F. (*littoralis*, Boisd.), on lucerne and cotton in Lower Egypt begin each year in early spring, and after several generations the moth reaches its maximum numbers about the end of June and beginning of July. Between the end of July and early August its numbers decrease very rapidly, although there is no increase in the percentage of parasitism. The beginning and end of the outbreak are determined entirely by temperature, since humidity varies little throughout the season, owing to irrigation. Experiments under laboratory conditions on the influence of constant and varying temperatures on the rate of development of the various stages proved that development is not in a direct proportion to time, but can be regarded as a regularly retarded movement. The author discusses the concept of critical thermal points for development of insects, and concludes that such points do not exist in the biological sense, and that development can continue, though it may be much retarded, at any temperature that is not injurious to the organism. The extreme temperatures, which are injurious, are of particular importance, since they control outbreaks of insects and determine the length of stages in their development. Average temperatures are, therefore, of very little value, since they do not reflect departures from optimum conditions.

509. FURTHER SURVEYS OF INSECT AND FUNGOID INCIDENCE ON IMPROVED ISHAN AND OTHER COTTONS IN NIGERIA. By F. D. Golding. (*Eighth Ann. Bull. of the Agr. Dept., Nigeria*, 1929, p. 110.) 1. Surveys have been made of the factors affecting the development of improved Ishan A., Ilorin and Kabba cotton grown through yams at Ilorin; of Ishan A. and Allen grown as sole crops at Badeggi (near Bida); and of Ishan A. and Meko grown through yams at Ibadan. In each locality the main object of the experimental work was to compare the susceptibility to disease, and the yield, of Ishan A. and the local cotton under conditions typical of that particular locality.

2. *Ilorin.*—(*a*) Cotton stainers were more numerous and bacterial disease more prevalent than in the 1927-28 season; but bollworms and jassids were less abundant. The plant bugs, which did so much damage to Ishan cotton last year, were scarce, and it is hoped that their abundance in 1927-28 was abnormal. The virus disease, Leaf Curl, was rarely seen.

(*b*) Ishan A. produced a higher proportion of clean seed cotton than Ilorin, and although its yield was less, the value of its crop was greater.

(*c*) The principal cause of the lower yield obtained from Ishan A. was a greater susceptibility to boll shedding. The yield of Kabba compared unfavourably with those of the other varieties for the third year in succession.

(*d*) One plot of Ishan and one of Ilorin were grown on soil with a very low specific conductivity, and one plot of each variety was grown on soil with a higher specific conductivity. When the specific conductivity was low fewer flowers were produced, and a lower yield was obtained; cotton stainers were less active, but there was, usually, more damage to ripe bolls from bollworms and bacterial disease. These results are similar to those obtained by Lean in 1926. Contradictory results were obtained on the following points: When the specific conductivity was low, shedding and mummification were, with one exception, higher; flowering and bolling were not delayed, and a smaller proportion of the crop was stained.

(*e*) The principal factor inhibiting yield at Ilorin appears to be the poor quality of the soil. It is thought that good yields will only be obtained on a few particular plots. Much of the soil is poor in the vicinity of Ilorin, and it is sug-

gested that, after next season, cotton variety tests should be confined to the principal cotton-growing area of the Ilorin Province—viz., Bode Sadu.

3. *Badeggi.*—(*a*) Cotton stainers were about eleven times more numerous on Allen than on Ishan; there was little difference in the bollworm infestation on the two varieties.

(*b*) The boll shedding of Allen was normal, but that of Ishan was excessive for an indigenous cotton, and is thought to have been due chiefly to soil desiccation and the prevalence of bacterial disease.

(*c*) The growth of the Ishan plants was poor, and they gave a yield only two-fifths as great as that of Allen. Allen cotton appears to be more suited to the conditions appertaining in the Badeggi district.

4. *Ibadan.*—(*a*) Cotton stainers were numerous, possibly on account of the proximity of some exotic cotton, and bollworms did much damage to ripe bolls late in the season. There was little difference in the susceptibility of Ishan and Meko cottons to these insect pests and to bacterial disease.

(*b*) There were fewer Ishan plants per acre than Meko, and, owing to variations in yam germination, Ishan encountered greater competition from the intercropped yams; in spite of these disadvantages Ishan gave a higher yield than Meko. The Ishan crop contained less stained seed cotton, and was worth $1\frac{3}{4}$ times as much as the Meko crop.

[*Cf.* Abstr. **232**, p. 195, Vol. VI., of this Review.]

510. COMPARATIVE OBSERVATIONS ON THE PESTS OF COTTON IN THE BENUE PROVINCE OF NIGERIA. By O. B. Lean. (*Eighth Ann. Bull. of the Dept. of Agr., Nigeria*, 1929, p. 130.) A study has been commenced of the factors that influence the production of cotton in the Benue Province, the improved Ishan A. from Ibadan being compared with the indigenous Munshi cotton when grown through yams. The experiment was undertaken under very poor conditions, with small plants and low flower production—conditions that are rather typical of the average Munshi farm. Drought in July and August was the most important factor, as it was impossible to secure a good stand of cotton through yams. Under these conditions the Munshi cotton was more successful than the Ishan. In spite of the fact that the Ishan shed nearly three times as many buds as the Munshi, it produced more flowers. As, however, the Ishan shed nearly twice as many bolls as the Munshi, about the same number of bolls were harvested. Further, as fewer Munshi bolls were damaged, the final yield was considerably greater from the Munshi cotton.

The following are the advantages which the Munshi cotton appears to enjoy over the Ishan A: Many fewer buds and bolls shed; bolls less attacked by bugs and bollworms; slightly fewer bolls mummify; less attractive to stainers and leaf roller; much less susceptible to leaf roll. The Ishan cotton grown in the Benue Province is not of the same high quality as that grown at Ibadan, and on first year's results it would appear that this variety is not suitable for replacing the Munshi cotton.

511. COTTON PESTS IN MALTA. By P. Borg. (Typescript *Malta Dpt. Agr.*, March, 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 261.) In exceptionally dry years, probably owing to the scarcity of its natural food plants, *Allophylax* (*Phylax*) *melitensis*, Baudi, has caused considerable injury to seedlings of cotton by gnawing the stems and removing the bark. This Tenebrionid is very common, and large numbers are observed early in the summer feeding on wild plants and the remains of crops recently removed from the field. Good results were obtained by lightly dusting the plants with lead arsenate, and also by means of baits made of offal and lead arsenate worked into a paste with water.

In the spring of 1925 numbers of cotton bolls were injured by *Earias chlorana*, L. A minor outbreak occurred the following year. The damage was reduced by collecting and burning the infested bolls. In Britain the larvæ of this moth feed on willow.

512. SOUTHERN RHODESIA. *Cotton Pests.* (*Rpt. of Sec., Dept. of Agr., S. Rhod.*, 1929.) The chief pests studied during the year were the Cotton Jassid (*Empoasca fascialis*) and Stainers (*Dysdercus* spp.), and detailed reports of the investigations have been received. Apparently definite primary injury to growing cotton plants by Termites was recorded early in the year. As the result of the experimental poisoning of adult beetles of the so-called Wireworms (*Trachynotus* sp., Fam. *Tenebrionidæ*) at the Cotton Breeding Station, Gatooma, in May, 1928, the mortality of cotton plants from this cause was conspicuously decreased, and the measure was not only repeated at the Station this year, but was practised by a number of farmers in the district.

513. COTTON INSECT PROBLEMS IN THE UNITED STATES. By B. R. Coad. (*Fourth Int. Cong. Ent., Ithaca, N.Y.*, 1928, ii. (Trans.), p. 241. Tring, England, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A. **6**, 1930, p. 305.) Short accounts are given of the more important pests of cotton in the United States, and of the measures adopted for their control.

514. LIST OF PESTS OF ECONOMIC PLANTS IN THE REGION OF BOKHARA AND OF THEIR PARASITES AND INSECT PREDATORS. By V. V. Yakhontov. (*Trudui Shirabud. opuitn. s.-kh. Sta. Otdel Zashch. Rast.* [Works Agr. Expt. Sta., Old Bokhara (Shirabudin), Dept. Plant. Prot.] No. 1, Staraya Bukhara, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 258.) Descriptions in English and Russian are given of the adult and second instar larva of *Anaphothrips* (*Hemianaphothrips*) *shirabudinensis*, sp.n., and the adult of *Thrips gossypii*, sp.n., both infesting cotton. Annotated lists of insects predacious or parasitic on the pests, arranged under the hosts, are also given.

515. ADAPTATION OF COTTON PESTS TO WEEDS IN THE REGION OF BOKHARA. By V. V. Yakhontov. (In Russian.) (*Works Agr. Exp. Sta., Old Bokhara* (*Shirabudin*), *Dept. Plant. Prot.*, No. 1, Staraya Bukhara, 1928. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 258.) Notes are given on 48 pests of cotton observed in the Bokhara region in 1926 and 1927, showing the alternative food plants of each on the basis of personal observations, and data from the literature. Most of the pests are general feeders, migrating from cultivated plants to weeds and *vice versa*.

516. THE DEVELOPMENT OF A CONTROL PROGRAMME FOR THE MEXICAN COTTON BOLL WEEVIL, AND SOME OF ITS RESULTS. By W. E. Hinds. (*4th Int. Cong. Ent., Ithaca, N.Y.*, 1928, ii. (Trans.), p. 175. Tring, England, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 304.) The history of the Cotton Boll Weevil as a pest of cotton, and the development of control measures in the United States are reviewed.

517. THE PRESENCE IN GEORGIA OF BRACON MELLITOR, SAY, A PARASITE OF THE COTTON BOLL WEEVIL. By J. H. Miller and G. F. Crisfield. (*J. of Econ. Ent.*, 23, 3, 1930, p. 607.) The weevil parasite, *Bracon mellitor*, has appeared this year in cotton fields in all parts of this State investigated. The first braconids were found in June, and then continuously until September 15, when the work was temporarily halted. The number of weevil larvæ destroyed in this manner ran as high as 18 per cent. in bolls, and 35 per cent. in hanging squares in August in the field which was under constant observation.

518. Dusting Cotton with Calcium Arsenate for Boll Weevil Control. By J. M. Robinson and F. S. Arant. (*Circ. Alabama Agr. Exp. Sta.*, **53**, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **5**, 1930, p. 222.) Tests with calcium arsenate dusts for controlling the boll weevil in Alabama have been carried out over a period of five years. On three different types of soil the dust was found to result in an average gain of 184 lb. of seed cotton to the acre, each acre receiving 40 lb. of the dust each season. The treatment was successful on either wet or dry foliage, but dusting is only profitable when the infestation exceeds 10 per cent., and when the potential yield is half a bale or more to the acre.

519. Cotton-Seed Disinfection as a Control for the Pink Bollworm (*Pectinophora gossypiella*, Saund.) By R. E. McDonald. (*4th Int. Cong. Ent., Ithaca, N.Y.*, 1928, ii. (Trans.), p. 552. Tring, England, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 313.) *Platyedra* (*Pectinophora*) *gossypiella*, Saund., was introduced into the part of Texas west of the Pecos River about ten years ago. In this region cotton is grown, with one exception, in high isolated valleys where the winter is much colder than is usual in cotton-producing countries, temperatures of 10° F. being not unusual. Many larvæ hibernate in the ground or in rubbish on the surface or within old bolls in the field, but the practice of pasturing fields and cleaning up preparatory to planting causes a rather high mortality, which is undoubtedly increased in Western Texas by the severity of the winters. The larvæ hibernating in stored cotton seed escape the cold, and the control secured in the areas under discussion is certainly due to the disinfection of cotton seed as a continuous process of ginning.

The heating apparatus now most generally employed is described. This is built round the conveyor already in use, and the seed is disinfected in the minute or a little more that elapses between the time it leaves the gin and the time it reaches the loading chute. Where ginning plants are already equipped with steam boilers, the cost probably does not exceed 10d. per ton of seed. When climatic conditions permit a higher rate of survival in larvæ hibernating outside the seed, it is probable that seed disinfection alone cannot be depended on for complete control.

520. Biological Notes on the Pink Bollworm (*Pectinophora gossypiella* Saund.) in Texas. By F. A. Fenton. (*4th Int. Cong. Ent., Ithaca, N.Y.*, 1928, ii. (Trans.), p. 439. Tring, England, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 309.) Investigations carried out in Texas upon the *Platyedra* (*Pectinophora*) *gossypiella*, Saund. (pink bollworm), showed only 4 per cent. over-wintering below ground. This may have been due to the fact that a hard crust is formed after irrigation. Winter irrigation following winter ploughing proved the most effective measure.

521. The Pink Bollworm of Cotton in the Punjab. By M. A. Husain. (*Seasonal Notes, Agr. Dpt., Punjab*, vii., **1**, 1930, p. 55.) A brief account of the life history of the pest, and the assistance rendered by the Indian Central Cotton Committee in its control.

522. Pink Bollworm in the United Provinces, India. (*Rpt. Dpt. of Agr. United Provs. of Agra and Oudh.*, 1929, p. 60.) Pink bollworm causes losses of 1·3 crores in the season. A great amount of investigation into this pest has been carried on, and the suggested procedure is to treat all seed by heating, and to allow no untreated seed to be used.

523. The Pink Bollworm Situation in Australia. By F. G. Holdaway. (*4th Int. Cong. Ent., Ithaca, N.Y.*, 1928, ii. (Trans.), p. 73. Tring, England, 1929. Abstr. from *Rev. App. Ent.* xviii., Ser. A., **6**, 1930, p. 299.) The question of the identity and distribution of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., and

P. (*P.*) *scutigera*, Hold., in Australia is reviewed, and the possibility of the former species being indigenous to India, Africa, and Australia is discussed in connection with Wegener's hypothesis on the origin of continents.

[*Cf.* Abstr. **229**, p. 154, of this Review.]

524. RAPPORT ENTOMOLOQIGUE POUR LA PROVINCE DU KATANGA, 1928. By C. Seydel. (*Bull. Agr. Congo Belge*, xx., **2**, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 260.) The most important pest is the pink bollworm, which was discovered on cotton in 1927. The original infestation was traced to cotton seed from Manyema. The usual measures of control against this pest are enumerated.

525. UN NOUVEAU PARASITE DU COTONNIER AU MAROC (*Platyedra vilella*, Zeller). By J. Mimeur. (*Rev. Path. Veg.*, xvii., **1**, Paris, 1930. Abstr. from *Rev. App. Ent.* xviii., Ser. A. **6**, 1930, p. 291.) *Platyedra vilella*, Zell., has been recorded from various parts of Europe, North Africa, and Asia Minor, but has never been considered a pest, as the larva was only known to attack the wild malvaceous plants, *Lavatera arborea* and *Malva sylvestris*. During 1929, in Morocco, the larvæ were found devouring the ovaries and flower buds and capsules of cotton plants. Their entrance holes resembled those of *Earias insulana*, Boisd., the larvæ generally occurring at the base of the calyx, near the flower peduncles, or on the tips of the bolls.

526. COTTON FLEA HOPPER. (*42nd Ann. Rpt. Texas Agr. Exp. Sta.*, 1929, p. 43.) Greater damage was caused by this pest during the year under review than at any time since 1926. The most important finding of the season was that Delfos cotton appears to be immune to cotton flea hopper injury.

527. THE COTTON FLEA HOPPER (*Psallus seriatus*). By W. V. King. (*4th Int. Cong. Ent., Ithaca, N.Y.*, 1928, ii. (Trans.), p. 452. Tring, England, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 310.) Cotton is not the natural food-plant of this Capsid, and its attack is undoubtedly associated with conditions affecting its more normal food-plants. As a consequence, infestations usually last only a short time, and although in cases of severe attack the entire bottom part of the crop may be destroyed, the plant recovers rapidly after the insects migrate, and the top branches produce normally.

528. SOME POSSIBLE MEANS OF CONTROL OF THE DAMAGE CAUSED BY THE COTTON-LEAF WORM MOTH TO THE FIG. By F. M. Hull. (*Jour. Econ. Ent.*, 22, **5**, 1929. Abstr. from *Exp. Sta. Rec.*, 62, **7**, 1930, p. 655.) The figs are damaged by periodic settling of swarms of moths on the fruit, with souring of the figs as a result. Several poison baits tested gave promise of considerable success in the control of the pest. The repellents tested were not as effective.

529. THE STATUS OF THE COTTON-LEAF WORM (*Alabama argillacea*, Hbn.) IN THE WEST INDIES. By H. A. Ballou. (*4th Int. Cong. Ent., Ithaca, N.Y.*, 1928, ii. (Trans.), p. 94. Tring, England, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A, **6**, 1930, p. 300.) Since 1903 (a year after the commencement of the cotton-growing industry) the cotton-leaf worm has occurred every season in all islands but St. Vincent, where only slight attacks have been observed. The eggs are parasitized by *Trichogramma* and *Telenomus*, and a Chalcid and a Sarcophagid have been obtained from the pupæ. Wasps of the genus *Polistes* are very efficient predators, but unfortunately they appear to be dying out in some of the islands as a result of the attacks of a small moth that invades the nests. Dusting with Paris green, London purple, or calcium arsenate is effective in control, but the frequent heavy showers during the growing season necessitate its repetition at short intervals.

530. Factores que Determinan el Control del "Arrebiatado" del Algodonero en los Valles de Lima, Huacho, y Cañete. (The Factors checking the Cotton Stainer in the Valleys of Lima, Huacho, and Canete.) By J. B. Pope. (*La Vida Agr.*, vii., **75**, Lima, 1930. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., Pt. 7, 1930, p. 359.) The stainer is checked in some districts by the time of incidence of the "close season," and also by irrigating the seed furrows when plants are a fortnight old, which covers the ground with a layer of soil and destroys the young nymphs and eggs about to hatch.

531. The Relation of Evaporation to Killing Efficiency of Soap Solutions on the Harlequin Bug and other Insects. By B. B. Fulton. (*J. of Econ. Ent.*, 23, **3**, 1930, p. 625.) Tests of various known contact insecticides on the Harlequin Bug, *Murgantia histrionica*, brought out the fact that certain soap solutions are very effective, but only under conditions of low evaporation. Further experiments under known rates of evaporation show that the efficiency of soap solution is indirectly proportional to the rate of evaporation. The addition of hygroscopic substances did not materially increase the effectiveness. Tests with several kinds of soap and two other species of insects show that the relationship is probably a general one.

[*Cf.* Abstr. **99**, p. 71 of this Review.]

532. Study of Locusts in Palestine. (*Science* Supplt., lxxi., **1848**, 1930, p. x.) The migratory locust of Africa, which is now causing widespread damage throughout Northern Africa and the Near East, is being attacked as a major scientific problem by entomologists of the Hebrew University at Jerusalem. Recent studies by Drs. F. S. Bodenheimer, G. Fraenkel, K. Reich, and N. Segal have contributed new facts which will eventually be of use in conquering this age-old bringer of desolation and famine.

Although the locust is about the oldest of recorded insect pests, strangely enough very little positive knowledge has been gathered as yet regarding its biology, habits, and primary breeding places. One of the first things developed by the investigators at the University has been definite evidence that the locust is not strictly an insect of the desert, as has usually been supposed. There are strong indications that the primary breeding ground of the insects that make trouble in Egypt, the Sinai region, Transjordania, and Palestine is in the moderately moist borderlands of the desert, and that a bad locust year is almost always preceded by a decidedly rainy winter, giving the ground where the eggs are laid plenty of water in its upper layer. This hypothesis is supported by evidence gathered by earlier workers in the Sudan and elsewhere.

Studies both in laboratory and field indicate that the eggs are not formed in the body of the female locust until spring. After they are laid in the ground the young insects inside the shells require from two to four weeks before hatching. While they are passing through their five larval stages, growing larger each time they shed their skins, they begin their migratory march. In six or eight weeks they have become full-grown winged adults, and their migrations become the vast flights that darken the sun and strip fields and orchards bare. Their adult life seems to last about ten months, completing the year's cycle.

Locusts are decidedly insects of clear sky and hot sun. They avoid the ground and the stones upon it during the chilly hours of night, roosting on the vegetation, especially on shrubs. When the first signs of dawn appear they hop down to earth, and creep about in small clumps until the first direct sunlight reaches them. Then they stop and sun themselves for a time, standing broadside on, to get the full benefit of the early rays.

As the day warms up, the horde begins its march. It keeps relentlessly ahead, climbing over all natural obstacles, and not diverting from its set course even

when an easier route presents itself. If the weather is very hot, the insects stop for a siesta at midday, this time turning their bodies so as to expose as little surface as possible to the sun, or taking advantage of all chance patches of shade. On resuming their march in the afternoon they feed voraciously, cleaning everything bare where they stop for lunch. Late in the afternoon, when the temperature falls, they call a halt, again sunning themselves, seeking dark stones for warmth whenever possible. Then they climb the shrubbery for the night.

These reactions seem to be governed by temperature rather than by light, for it has been found that when the weather is very warm they will march all night. Locusts are decidedly warm-weather creatures. At all stages in their lives they like high temperatures, thriving best when the mercury stands so high in the tube that human beings are distinctly uncomfortable.

533. Control of Acrididæ in U.S.S.R. By I. A. Parfentjev. (*4th Int. Cong. Ent. Ithaca*, N.Y., 1928, ii. (trans.), p. 848, Tring, England, 1929. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **6**, 1930, p. 318.) The methods used for controlling locusts in the Russian Union, including baits, sprays, and dusts, are discussed.

534. The Locust Question in Soviet Russia. By I. N. Filipjev. (*Reprint No.* 10, *Lenin. Acad. of Agr. Sci. in U.S.S.R.* Inst. for Plant Protection, 1929.) Deals with four species of locusts: (1) The Asiatic or Migratory Locust (*Locusta migratoria*, L.); (2) the Moroccan Grasshopper (*Dociostaurus maroccanus*, Thunb.); (3) the Prussian or Italian Locust (*Calliptamus italicus*, L.); (4) the Siberian Grasshopper (*Gomphocerus sibiricus*, Thunb.). The literature on the subject is reviewed.

535. Phases of Locusts and their Interrelations. By B. P. Uvarov and B. N. Zolotarevsky. (*Bull. Ent. Res.*, xx., **3**, 1929, p. 261. Abstr. from *Rev. App. Ent.*, xviii., Ser. A., **2**, 1930, p. 55.) The authors suggest that the following names should be given to the various phases through which locusts pass: *Phasis solitaria* is applied to the extreme form, in cases in which only isolated individuals are present in a given locality; *Phasis transiens* designates the continuous series of transitional forms. When the transformation is in the direction from solitary to gregarious, the name *transiens* can be replaced by *congregans*, and in the case of the opposite process the term *dissocians* can be used. Finally, the extreme form, to which belong individuals forming large and dense migrating swarms, is called *Phasis gregaria*.

The following geographical subspecies of *Locusta migratoria*, L. are recognized by the authors: *Locusta migratoria rossica*, subsp. n., of Central Russia; the typical *Locusta migratoria*, L. of South-Eastern Russia; and *Locusta migratoria migratorioides*, R. and F., occurring in the subtropics and tropics. A diagram representing the interrelation of the phases of the three subspecies of *L. migratoria* is given.

The known phases of other locusts that have been recorded as distinct species are *Schistocerca gregaria*, Forsk., ph. *solitaria* (*flaviventris*, Burm.), *Nomadacris septemfasciata*, Serv., ph. *solitaria* (*coangustata*, Luc.), *Dociostaurus maroccanus*, Thnbg., ph. *transiens* (*degeneratus*, Baranov), and *Melanoplus mexicanus atlantis*, Riley, ph. *gregaria* (*spretus*, Walsh).

536. Tanganyika: Tsetse Fly Control. *Tsetse Reclamation Ann. Rpt.*, 1929. An account of the work of the sub-department concerned with tsetse control given under the following headings: General Remarks; Administration; Field Work: (*a*) Reconnaissance; (*b*) Direct Aid to Research; (*c*) Advances by Fly; (*d*) Experimental Reclamation of Ground already Infested; (*e*) Summary of the Practical Results of the Experimental Period.

Tsetse Research Ann. Rpt., 1929: Section I. deals with Administration; Section II. with Research as follows:

(A) General Remarks.

(B) Concept.

(C) Remarks upon the Several Investigations: (*a*) Reconnaissance, Primary and More Detailed; (*b*) Observations upon Fly Density—Activity, Breeding, and General Behaviour in Relation to Season, Weather Conditions, Vegetation, Game and Man; (*c*) The Autecology, Sociology, and Synecology of *G. morsitans*; (*d*) The Interrelations of *G. morsitans*, the Biome and the Physical Environment; (*e*) The General Relations of *G. morsitans* and Game; (*f*) The Alteration of Ecial Factors as Measures of Control and Combat; (*g*) The Direct and Indirect Influence of Fire in Control and Combat; (*h*) Biological Control; (*i*) The Making and Identification of Collections; (*j*) The Collection of Data of General Interest and Importance.

(D) Bereku Ridge Forest Reserve.

(E) Conclusion.

537. An Ideal Mounting Medium for Mycologists. By D. H. Linder. (*Science*, N.S., lxx., **1818**, 1929, p. 430. Abstr. from *Rev. App. Mycol.*, ix., **4**, 1930, p. 260.) Amann's mounting medium, consisting of 20 gm. each of carbolic acid crystals, lactic acid (syrup), and distilled water, with 40 gm. of glycerine, has been used by the writer for the past three years with eminently satisfactory results. The medium almost immediately restores the turgor of the specimens and obviates plasmolysis of fresh material, especially in the higher fungi, while at the same time it acts as a killing agent. Cotton blue (0·5 per cent.) is a suitable dye for use with this medium.

538. The Penicillia. By C. Thom. (Baillière, Tindall and Cox. London. 1930. Price 45s. net. Abstr. from *Jour. of Text. Inst.*, xxi., **7**, 1930, p. 129.) "The genus *Penicillium* includes some of the most widely distributed and some of the most destructive of all mould fungi. A number of species attack textiles, particularly cotton goods, and share with the *Aspergilli* the responsibility for well over 90 per cent. of the mildew damage sustained by the Lancashire cotton trade. . . . One of the most valuable features of the author's work is that he has studied, not a limited number of isolated strains, but literally thousands of cultures. . . . The book is not one to be read, but to be in daily use in the culture laboratory, and even at the rather high price it is a volume which no serious student of the saprophytic moulds can afford to be without."

539. Mildewed Yarn Fungi: Identification; Conditioning Agents; Fungicidal Power. By R. Lehmann. (*Spinn. u. Web.*, 48, **16**, 1930, p. 18. Abstr. from *Summ. of Curr. Lit.*, x., **11**, 1930, p. 264.) The following fungi were isolated from cultures of spores from mildewed yarn on malt extract-gelatin media: *Penicillium glaucum, Aspergillus glaucus, A. flavus, Rhizopus nigricans, Mucor racemosus, Hormodendron ochroleucum, Fusarium scirpi, Torula filorum, T. setosa, Oospora aurantiaca.* Tests were made of the action of various commercial wetting agents, and the percentages required to check the growth of the moulds were determined. Hygrolit was found to have the greatest fungicidal action, concentrations of 0·225 per cent. being sufficient to check the growth.

540. The Fungi Causing Mildew in Cotton Goods. By L. D. Galloway. (*J. of Text. Inst.*, xxi., **6**, 1930, T 277.) In connection with the routine examination of mildew cases, and with the testing of antiseptics suitable for use in sizing, it has been necessary to isolate a considerable number of mildew fungi in pure culture. This paper gives a brief summary of the occurrence and characteristics of the types thus isolated, and of the difficulties encountered in a preliminary classification.

The majority of species belong to the two genera *Aspergillus* and *Penicillium*, but *Fusarium* and other *Fungi imperfecti* are of common occurrence. It is shown that the raw cotton itself is the principal source of infection. Only a proportion of the fungi are capable of producing stains on cloth, and a still smaller proportion are capable of causing tendering under ordinary conditions of exposure.

541. Some Diseases of Cotton Fibres. By A. A. Jaczewski. (*Microbiol. Jour.*, ix., **1**, 1929. Abstr. from *Rev. App. Mycol.*, ix., **5**, 1930, p. 307.) The following fungi causing disease of cotton fibres are dealt with: *Nigrospora gossypii*, n. sp., *Macrosporium gossypii*, n. sp., *Cladosporium gossypii*, n.sp., *Brachysporium gossypii*, n.sp., *Helminthosporium nadsonii*, n.sp.

542. Plant Diseases in Abkhasia in 1928. By P. I. Nagorny and E. M. Eristavi. (*Pubns. Agr. Exper. Stat. of Abkhasia*, **38**, 1929. Abstr. from *Rev. App. Mycol.*, ix., **4**, 1930, p. 226.) From the summary, in German, we note that cotton in some localities was attacked by *A. gossypii* Woronichin, which was usually found to be associated with *Colletotrichum gossypii* and *P. gossypina.*

543. Les Maladies du Cotonnier dans l'Uele. By P. Staner. (*Bull. Agr. Congo Belge*, xx., **2**, 1929, p. 212. Abstr. from *Rev. App. Mycol.*, ix., Pt. 4, 1930, p. 240.) The diseases include *Bacterium malvacearum*, *Fusarium vasinfectum*, (?) *Nematospora gossypii*, and *Colletotrichum gossypii.*

[*Cf.* Abstr. **246**, p. 159 of this Review.]

544. Nigeria. *Cotton Diseases.* (*Bull. Imp. Inst.*, xxviii., **2**, 1930, p. 207.) The Senior Mycologist, Mr. T. Laycock, states that during the year 1929 experiments on the external disinfection of cotton seed for the control of diseases caused by the bacterium *Pseudomonas malvacearum* E.F.S. were repeated at Ilorin. The disinfection employed was Germisan, 1 in 0·2 per cent. soap solution, and there was a marked reduction of disease on treated plants at the beginning of the season, but later, owing to inefficient screens of guinea corn, both treated and untreated plants became affected.

Experiments were carried out to determine the effect of sun treatment of cotton seed to control *Pseudomonas malvacearum.* Ishan seed from Ilorin was exposed to the sun in an iron dish daily for two weeks in June, during which time the temperatures reached 60° C. at times. The plants grown from the treated seed showed no signs of disease.

Cage experiments were carried out to determine whether cotton stainer (*Dysdercus* spp.) nymphs of the fifth and sixth instar could infect cotton bolls with internal boll disease due to *Nematospora gossypii* Ashby and Nowell. Flowers were screened on plants grown in cages, and when the resulting bolls were from four to six weeks old stainer nymphs were introduced. The cotton bolls were examined on opening, and at the time of reporting sixteen had been found to contain the fungus. All the controls had given negative results thus far.

545. Southern Rhodesia. *Cotton Diseases.* (*Rpt. of Sec., Dept. of Agr., S. Rhod.*, 1929.) Internal rots have been shown to be due to two wound parasites, *Epicoccum purpurascens* and *Alternaria* sp., by inoculation on both picked and growing bolls, but owing to pressure of work a complete study of the diseases has not yet been possible. Internal boll disease due to *Nematospora coryli* has been confirmed.

546. A List of Plant Diseases occurring in Southern Rhodesia. By J. C. F. Hopkins. (*Rhod. Agr. Jour.*, xxvii., **5**, 1930, p. 523.) The following are given for cotton: Angular Leafspot, Anthracnose, Blackarm, Black Rust, Boll Drop, Boll Rot, Internal Boll Disease, Internal Boll Rot, Leaf Spot, Sore Shin.

547. THE DEVELOPMENT IN CULTURE OF ASCOCHYTA GOSSYPII, SYD. By H. G. Chippindale. (*Trans. Brit. Mycol. Soc.*, xiv., 3-4, 1929, pp. 201-215. Abstr. from *Rev. App. Mycol.*, ix., Pt. 4, 1930, p. 240.) Among the various media tried by the author, Coon's modified agar (the composition of which is given) proved to be suitable for the production and study of the fruit bodies. On this medium the fungus produced, besides pycnidia and clamydospores, large catenulate, *Alternaria*-like resting spores, which are fully described and termed "hypnocysts." The pycnidia are formed by the segmentation of one to four cells in a hypha (occasionally in two and rarely in more hyphæ), which gives rise to a parenchymatous mass of tissue. Both the central and ostiolar cavities in the pycnidium are formed by mucilaginous histolysis. The pycnospores are budded off the cells lining the central cavity.

The results of experiments made to test the effect of environmental conditions of the fungus showed that light did not affect either its mycelial growth or the production of the fruiting bodies. The organism is, however, very sensitive to changes in temperature, and excess of carbon dioxide inhibited the production of pycnidia.

548. ANGULAR LEAF-SPOT DISEASE OF COTTON. By R. H. Stoughton. (*Nature*, cxxv., 3149, 1930, p. 350. Abstr. from *Rev. App. Mycol.*, ix., 6, 1930, p. 377.) In order to test the validity of the recently advanced hypothesis that blackarm or angular leaf-spot disease of cotton (*Bacterium malvacearum*) may involve systemic infection without any external symptoms except where environmental conditions favour their development, the writer conducted a series of experiments at the Rothamsted Experimental Station on cotton plants growing in a specially constructed apparatus enabling soil and air conditions to be independently controlled.

Cotton seed from the Sudan, derived from heavily infected plants, and thus, on the basis of the above theory, presumably internally infected, was grown at varying soil temperatures with all other environmental factors constant. Seed subjected to thorough external disinfection produced seedlings showing no sign of disease at any temperature, while those from untreated seed showed a slight amount of infection, which reached its maximum at 27° C. Plants from seed soaked in a strong suspension of the organism showed a considerably greater degree of infection, again with a maximum of 27° C., but with a certain amount even at 40° C. (several degrees above the maximum at which *Bact. malvacearum* has been grown in pure culture). Finally, seed in which the organism had been artificially introduced within the seed coat produced seedlings which were nearly all infected at all temperatures, even up to 40° C. These results lend no support to the theory of natural internal infection, but indicate that primary infection arises from the attack of bacteria present on the outside of the seed.

In order to test the theory of latency of the parasite within the plant, the same seedlings that had shown primary infection were allowed to continue their growth under conditions favouring the development of the disease, as shown by the fact that adjacent plants sprayed with a pure culture of the organism contracted heavy infection. In no case did the unsprayed plants show any further disease in the newly formed stems and leaves, as would be expected were the theory of internal spread correct. Laboratory attempts to isolate *Bact. malvacearum* from the tissues of the embryo have also given consistently negative results, but on one occasion it was obtained from between the seed coat and the embryo.

An interesting and possibly important point in connection with the life-history of the angular leaf-spot organism is the fact that it manifests the phenomenon of "dissociation." At least three "dissociates" have been isolated, all of which

are culturally, and to some extent morphologically, quite distinct, one being possibly identical with the so-called "common yellow saprophyte of cotton." These "dissociates" arise in single-cell cultures, and are apparently produced in an obligate order, "A" producing "B," "B" "C," and so forth; there is some indication that the cycle may be a closed one.

549. THE INFECTION OF COTTON PLANTS BY BACTERIUM MALVACEARUM IN CONTROL CHAMBERS. By R. H. Stoughton. (Internat. Botan. Congress, Cambridge, August, 1930.) Plants were grown in apparatus in which soil and air temperatures, air humidity, and illumination were independently controlled. In pure culture the organism grows best at temperatures near 25° C. Seed infected on the outside produces infected plants at all germination temperatures. Inoculation by spraying in conditions of high humidity shows that infection occurs at all temperatures up to 40°, being most severe on older leaves at high, on younger leaves at low, temperatures. [*Cf.* Abstr. **438**, p. 311, and **544**, **548**, above.]

550. PHYTOPHTHORA PARASITICA, DAST., CAUSING "DAMPING-OFF" DISEASE OF COTTON SEEDLINGS AND "FRUIT-ROT" OF GUAVA IN INDIA. By M. Mitra. (*Trans. Brit. Mycol. Soc.*, xiv., **3-4**, 1929, pp. 249-254. Abstr. from *Rev. App. Mycol.*, ix., Pt. 4, 1930, p. 240.) A morphological comparison of pure cultures of a strain of *Phytophthora*, which was found in 1926 causing a damping-off of cotton seedlings at Pusa (this being stated to be the first record of the fungus on this host in India), and of another strain causing a fruit rot of guava in Pusa, with cultures of *P. parasitica* from castor seedlings and other sources, showed that all were identical and referable to the "*microspora*" group of *P. parasitica* as emended by Ashby. Their identity was further proved by cross-inoculations of the three strains to each other's natural hosts and to *Sesamum* (*indicum*), since a high percentage of infection was obtained in each case.

551. DISSOCIATIONS AND ASSOCIATIONS IN SOME STRAINS OF FUSARIUM MONILIFORME. By L. H. Leonian. (*Phytopath.*, xx., **1**, 1930, p. 144. Abstr. from *Rev. App. Mycol.*, ix., **6**, 1930, p. 374.) Numerous strains of *Fusarium moniliforme* (*Gibberella moniliformis*) were isolated from maize plants showing root rot symptoms. These strains were shown by inoculation to possess varying degrees of pathogenicity. Some fifty variants were separated from a monospore culture of the most virulent of these strains. After discarding the less distinct types, there still remained twenty-five variants readily differentiable by their macroscopic appearance, and often also by their degree of pathogenicity. The stability of the types was found to be only relative and highly variable, a given variant splitting into new types or reverting to the original without system or regularity. A perfect blend usually resulted from artificial mixtures in petri dish cultures, the colonies derived from such arbitrary associations duplicating the natural dissociation types observed in plant cultures. When a purple form of these variants was mixed with an orange one, the latter representing a different isolation and undoubtedly a distinct strain, a perfect blend often resulted, and selection for several generations was necessary to induce segregation of the types in pure form. In one instance the blending was so complete as to produce intermediate and new types not hitherto observed. So far these new types have retained their characteristics despite protracted selection.

552. DISEASES OF THE COTTON PLANT. By N. G. Zaprometoff. (*Scient. Res. Inst. for Cotton Industry*. Study Series on Cotton Pests and Diseases, Tashkent, 1929. Abstr. from *Rev. App. Mycol.*, ix., **6**, 1930, p. 378.) (English summary.) In this pamphlet brief accounts are given of the principal parasitic diseases and physiological troubles of the cotton plant and cotton lint in Russian Central Asia. Extensive surveys have shown that wilt (*Fusarium vasinfectum*) is steadily

spreading, but on soils with a high content of common salt the incidence of wilt is very slight. Under local conditions the fungus does not form cankers or wounds on the collar of the cotton plants, and it was never seen to fructify on living plants in nature. There was, however, experimental evidence that both micro- and macroconidia may be formed in the spring on dead infected cotton stems remaining over winter in the field, this forming a probable source of aerial infection at the renewal of vegetation, although the disease is chiefly carried in the soil, in which the fungus is apparently capable of living indefinitely as a saprophyte on dead plant debris. It is believed that the local strain of *F. vasinfectum* may be different from the strains that have been described from other cotton-growing countries. In Central Asia the wilt disease has been recorded also on a number of other cultivated plants, but so far only the strain from *Hibiscus esculentus* has been found capable of infecting cotton. All cotton varieties cultivated in the locality appear to be more or less susceptible to wilt, although some exhibit a relatively high degree of resistance. The control measures recommended are the removal and destruction by fire of all cotton plants and debris after the harvest, the replacement of stable manure by artificial fertilizers (since it has been shown that stable manure greatly increases the incidence and virulence of the disease), the avoidance of too abundant irrigation, and the use of resistant varieties.

Collar canker (*Fusarium buharicum*) was very prevalent in 1928 on all varieties of Asiatic cotton (*Gossypium herbaceum*), of which the Bokhara variety appears to be the most susceptible. The disease differs from the wilt due to *F. vasinfectum* chiefly in its acute character, the diseased plants being very rapidly killed, and in the formation of definite swellings or cankers at the collar; the cankers are usually covered with a slight pale to dark blue black, dark green, pink, or white efflorescence of conidia, the blue colour being predominant. Infection may occur during the whole period of vegetation of the host, and artificial inoculation experiments have shown that it may take place either from infected seeds to the seedlings or through wounds in the developing plants. In these experiments the incubation period was from 2½ to 3½ weeks in the case of infected seed, and from 1½ to 3½ weeks in inoculations through wounds. In heavily infected areas the death-rate may be as high as 70 per cent., and cases were also recorded when the whole crop was lost. So far all the American varieties (Uplands) of cotton tested have proved to be immune from *F. buharicum*, even when sown together with infected Asiatic varieties.

Both American and Asiatic varieties of cotton also suffer from angular leaf-spot and blackarm disease (*Bacterium malvacearum*). Of minor economic importance are root rots, usually found to be associated with species of *Fusarium*, *Verticillium*, *Rhizoctonia*, and an undetermined species of *Aegerita* (said to be very prevalent in 1929); black root rot caused by *Thielaviopsis basicola*; a leaf spot caused by *Phyllosticta gossypina*, and sooty moulds.

553. A NEW SPECIES OF FUSARIUM ON COTTON PLANTS. By A. S. Letoff. (Reprinted from *Materials for Mycol. and Phytopath.*, viii., 1, 1929, Leningrad. [In Russian]. Abstr. from *Rev. App. Mycol.*, ix., 6, 1930, p. 379.) A brief account is given of an apparently hitherto undescribed disease which was observed in 1928 attacking cotton plants at the Kara-Tchala Cotton Seed Nursery in Azerbaijan (South-East Russia). The sole outward symptom of the disease was the sudden wilting and death of healthy and vigorous cotton plants at the stage of flowering (end of July to middle of August), the process rapidly extending around the initial infection foci even after the removal of the first dead plants. Examination of the latter showed that the vascular bundles in the roots and lower portions of the stems (occasionally also the parenchymatous tissues) contained hyaline or

brownish hyphæ, 3 to 4·5 μ in diameter, while some stems were found to bear externally pale blue or green sporodochia of a species of *Fusarium* belonging to the *Martiella* section. In pure culture the fungus is characterized by a profuse, rapidly growing, dense, white aerial mycelium. Substrata, such as gelatine or agar-agar, acquire an intense blue colour, but on potato or carrot slices the pigment formation is much weaker, and is entirely lacking on *Melilotus* stems. The aerial mycelium produces hyaline, ovate (predominant), elongated, reniform, or comma-shaped, mostly one-, but occasionally two- or three-celled microconidia in heads. The one-celled microconidia measure 6·6 to 20 by 1 to 6·6 μ, and the two- or three-celled ones 18 to 33 by 4 to 8·2 μ. Globular intercalary or terminal chlamydospores, 8 to 16·5 by 8 to 11·6 μ, also occur in the aerial mycelium either singly or in chains. In older cultures macroconidia are formed on mycelial strands, sporodochia, pseudopionnotes, and coremia. The macroconidia are hyaline when seen singly under the microscope, but in mass they vary from dirty greyish-yellow or dirty sky-blue to dark blue with age. The normal mature macroconidia are slightly curved, rounded at both ends, narrower at the base than at the apex, with an indistinct pedicel, mostly (85 to 99 per cent.) three-septate (33 to 47 by 3 to 6·6 μ), more rarely with one or two septa (22 to 35 by 3 to 6·6 μ), or with four or five septa (40 to 55 by 3 to 6·6 μ). The conidiophores are simple or dendritically branched. The macroconidia germinate at both ends, and anastomosis of the germ-tubes was observed. In old, drying-up cultures one or two globular, one-celled chlamydospores, 9 to 13 by 6 to 10 μ, may be formed in the macroconidia. No stroma was seen. The fungus is considered to be new to science and is named *F. caucasicum*.

In describing the main differences between the new species and *F. cœruleum*, *F. solani*, and *F. buharicum* Jacz. (the emended spelling adopted by the author, in agreement with Jaczewski, for *F. bucharicum*), it is stated that in the last-named species the aerial mycelium is almost entirely lacking on all media; its fructifications are typical pionnotes, light pinkish-brown, and later black on agar-agar, pinkish-red on rice, and greenish-blue on potato slants and *Melilotus* stems. The macroconidia, which produce an abundance of chlamydospores, are slightly curved, mostly (50 to 70 per cent.) five-septate (38 to 54 by 4·5 to 7·5 μ), more rarely with three (30 to 49 by 4·5 to 7·5 μ) or four septa (34 to 43·5 by 6 to 7·5 μ). Sclerotial bodies are formed by *F. buharicum*, both in nature and in cultures.

The pathogenicity of *F. caucasicum* (a Latin diagnosis of which is given) was tested in 1929; it proved to be very virulent on the cotton varieties Triumph-Navrotzky and 182, both by soil and direct seedling inoculation, less on the varieties Navrotzky and 169, and failed to produce infection on Bokhara cotton (*Gossypium herbaceum*). Most of the cotton seeds sown in inoculated soil failed to germinate, and were found to have rotted in the soil.

554. ON THE METABOLISM OF NEMATOSPORA GOSSYPII AND RELATED FUNGI, WITH SPECIAL REFERENCE TO THE SOURCE OF NITROGEN. By E. H. M. Farries and A. F. Bell. (*Ann. Bot.*, xliv., 1930, p. 423.) The fungi *Spermophthora gossypii*, *Nematospora coryli*, and *N. gossypii* (two strains) are somewhat selective as regards carbon food supply; they cannot ferment sugary liquids. They do not grow upon a medium in which asparagine is the source of nitrogen, but grow freely with peptone or lemco. Considerable detail is given as to nitrogen supply.

555. RHIZOCTONIA SOLANI (KUHN) ON COTTON IN TRINIDAD, 1929-30. By J. West. (*Trop. Agriculture*, vii., **8**, 1930, p. 223.) During the summer of 1929 the mycology plots were under a heavy crop of Bengal bean (*Stizolobium deeringianum*). This was cutlassed and ploughed in in mid-November. The plots were ridged up immediately and planted with Sea Island cotton. Later they were replanted with Sea Island and Million Dollar cotton. Both soaked and

unsoaked seed were used. Germination showed above 90 per cent. under test. Heavy mortality, due to *R. solani*, occurred with both types of cotton.

The following factors probably aided this infestation: (1) Decomposing trash in the ridges offered an ideal medium. (2) Some of the planting was done on top of the ridges, where the soil "puddled." Seed planted too deep. (3) Heavy rains immediately after sowing. (4) Tendency of the soil to "bind" when drying out. Infections were of three types: (*a*) The germinating seeds were killed before they emerged above the soil crust; (*b*) young seedlings were attacked at ground level—the majority dying, but a few recovering; (*c*) occasionally three to four weeks old plants were attacked and died.

556. Cotton Root Rot Investigations. (*42nd Ann. Rpt. Texas Agr. Exp. Sta.*, 1929.) A detailed account of root rot disease dealing with modes of over-wintering, avenues of spread, soil reaction, and methods of control.

[*Cf.* Abstr. **252**, p. 160, and **380, 381**, pp. 245, 246 of this Review.]

557. Soil Reaction as Influencing Phymatotrichum Root Rot. By W. N. Ezekiel and J. J. Taubenhaus. (Abt. in *Phytopath.*, xx., **1**, 1930. From *Rev. App. Mycol.*, ix., **6**, 1930, p. 380.) Cotton was planted in rows 12 ft. long in boxes of seven different soils, and root rot (*Phymatotrichum omnivorum*) induced by inoculation at one end of each row. The disease spread furthest in soils of pH 7·6 and 7·7, but attacked only one inoculated plant in acid soils (pH 5·5 and 5·8), the effects in soils of pH 6·3, 6·7, and 7·1 being intermediate. Three other inoculation experiments yielded similar results, confirming the outcome of previous field surveys, and showing that root rot is destructive in alkaline soils, but unimportant in acid ones. The addition to the soil of excessive quantities of sulphur produced an acid reaction, and a consequent decrease of infection, but this method is still in the experimental stage, and cannot yet be recommended for general use.

558. Airplane Photography in the Study of Cotton Root Rot. By J. J. Taubenhaus *et al.* (*Phytopath.*, xix., **11**, 1929, p. 1025. Abstr. from *Rev. App. Mycol.*, ix., Pt. 4, 1930, p. 241.) It has been found almost impossible to secure photographs from the ground satisfactorily showing the relative losses caused by cotton root rot (*Phymatotrichum omnivorum*) in fields or plots of more than a single row. This problem has been solved by aeroplane photography, which shows up the root rot patches well. Fairly sharp results may be obtained with a Graflex camera or with a focal-plane hand camera, such as the Cycle Graphic, but for more accurate work a specially designed apparatus—*e.g.*, the Folmer type A-1—is desirable. Ordinary films may be used in clear atmospheric conditions up to a height of 500 ft., but more reliable results are given by Eastman panchromatic films with an Aero L or Wratten Kl (light yellow) filter.

559. Cotton Root Disease. (*42nd Ann. Rpt. Exp. Sta., Ga.*, 1929, p. 18.) During the period under review no data could be obtained on the control of the root diseases caused by *Fusarium moniliforme*, since the fungus was so abundant that treated and untreated seed alike showed 100 per cent. infection. In order to obtain more definite information regarding the value of seed treatments and the damage resulting from various seed-borne diseases, four brick-walled beds were prepared measuring 6 by 50 ft. inside, the seed in each being respectively untreated, dusted with mercuric chloride, delinted and soaked for 30 minutes in a 1 in 1,000 solution of mercuric chloride, and dusted with mercuric resinate. A slight amount of angular leaf-spot appeared in the fourth bed, the organism apparently having been blown in from a field 150 yards away. The yields of seed cotton were respectively 1·5 lb., 4·47 lb., 5·6 lb., and 3·97 lb.

560. Root Strangulation Disease. By J. J. Taubenhaus *et al.* (*Science*, Supplt., lxxi., **1847**, 1930, xiv.) Cotton plants are strangled to death by hard,

dry clay in a new disease discovered by J. J. Taubenhaus and others of the Agricultural Experiment Station, College Station, Texas. "Root strangulation," as the disease has been named, occurs only in flat, poorly drained, heavy clay soils, which are compacted by continuous rain or irrigation. The affected plants wilt and die suddenly. When the dead plants are pulled they appear to have no roots. However, a careful investigation shows that the plants do have a well-developed root system, but that the hard soil literally strangles the plants to death by constricting the roots and preventing the passage of moisture from the soil to the top of the plant.

561. VERTICILLIUM HADROMYCOSIS (WILT) OF COTTON IN CALIFORNIA. (*Plant Disease Reporter*, xiv., 1930 (Mimeographed). Abstr. from *Rev. App. Mycol.*, ix., 6, 1930, p. 380.) *Verticillium* hadromycosis or wilt of cotton was first observed near Wasco in the southern San Joaquin valley of California in September, 1927. Before 1923 this field was planted with lucerne and barley, and from 1925-26 it was in cotton, with water-melons interplanted in 1925. Potatoes were planted in the spring of 1927, but were afterwards replaced by cotton. The wilt disease having been noticed for the first time after the potato planting, it is thought probable that the fungus was introduced into the soil with this crop. *Verticillium* wilt was detected in small quantities in several fields in 1928, and during the current season the disease has assumed an alarming character, 50 per cent. of the crop being affected in one case. The cultural characters of the *Verticillium* isolated from wilted cotton stems agree, apart from certain minor variations, with those of *V. alboatrum*.

[*Cf.* Abstr. 564.]

GENERAL BOTANY, BREEDING, ETC.

562. STUDIES ON THE TRANSPORT OF NITROGENOUS SUBSTANCES IN THE COTTON PLANT. III. THE RELATION BETWEEN LONGITUDINAL MOVEMENT AND CONCENTRATION GRADIENTS IN THE BARK. E. J. Maskell and T. G. Mason. (*Ann. Bot.*, xliv., No. 173, 1930.) The following is a summary of the authors' conclusions:

(1) When movement of nitrogen down a stem is brought to a standstill by removal of the leaves and ringing the stem close to the ground, there still remains a marked negative gradient in protein N and crystalloid N in the bark. On the other hand, when the movement of carbohydrates is similarly brought to a standstill, the sugar gradient disappears. Thus while zero movement of nitrogen is associated with a negative gradient in the bark, zero movement of carbohydrates is associated with zero gradient.

(2) Where downward movement of nitrogen is still proceeding the negative gradients in protein N and crystalloid N are smaller than where downward movement is brought to a standstill.

(3) It is suggested that the negative gradient in nitrogen observed in the bark of the normal plant consists of two components, a negative static gradient of storage nitrogen which persists after movement ceases, and a positive dynamic gradient of translocatory nitrogen, which disappears when movement ceases.

(4) Reversal of the normal downward direction of movement of carbohydrates and of nitrogen is accompanied by a reversal of the gradient of sugars and a steepening of the originally negative gradient of nitrogen compounds. This change in the nitrogen gradient is interpreted as the reversal of an originally positive dynamic gradient, superimposed on a relatively constant static gradient which is negative. That these changes in gradients are almost entirely confined

to the inner half of the bark supports the suggestion that the dynamic gradient is in the sieve-tubes, and the static gradient is mainly due to nitrogen stored in the other tissues of the bark.

(5) The total dynamic gradient is calculated by means of a simple approximate formula and compared with the total movement of nitrogen. Judging from the observed relation between gradient and movement of carbohydrates, the dynamic gradient in total N, protein N, and amino-acid N would be adequate for the amount of nitrogen movement observed.

(6) This suggests (*a*) that the acceleration mechanism in the sieve-tubes acts impartially on sugars and nitrogen compounds, and (*b*) that either total N, protein N, or amino-acid N may be associated with longitudinal movement. It is pointed out that the presence of sieve-pores should render the movement of colloids possible, and that if colloids in solution are moved, then crystalloids of every kind should also take part in translocation.

563. Studies on the Transport of Nitrogenous Substances in the Cotton Plant. IV. The Interpretation of the Effects of Ringing, with Special Reference to the Lability of the Nitrogen Compounds of the Bark. By E. J. Maskell and T. G. Mason. (*Ann. Bot.*, xliv., 1930, p. 233.) It was concluded from the previous studies on the transport of carbohydrates that they travelled longitudinally through the bark, chiefly as sucrose. This was based upon evidence to the effect that diurnal variation in carbohydrate content is almost entirely due to sucrose; that sucrose accumulates in the bark above, and diminishes below, a ring, much more than do reducing sugars; that the vertical gradient of sugar concentration is largely a gradient of sucrose; that sucrose shows high concentration in the inner zone, which contains most of the sieve tubes, and low in the outer, while reducing sugars show the reverse; and that the response of sucrose to ringing is mainly in the region of the sieve tubes.

The summary of the present paper is much as follows:

A. *The Crystalloid N-Protein N Relation to Bark, Wood, and Leaf.*—1. Conversion of crystalloid N to protein N and *vice versa* in the bark may be rapid compared with the rate of longitudinal transport of N. Without appreciable alteration in total N content, the proportion of crystalloid N may alter considerably in a short time. This marked lability is not shown by the protein and crystalloid N of wood and leaf.

2. As to the factors affecting the ratio of crystalloid N to protein N in the bark:

(*a*) Decrease of sugar concentration causes conversion of protein to crystalloid N. High negative correlation.

(*b*) Decreased H-ion concentration is associated with an increased proportion of crystalloid N. Correlation not significant.

(*c*) Desiccation causes conversion of crystalloid N to protein N, but the concentration of crystalloid N does not diminish.

(*d*) A very rapid fall in the proportion of crystalloid N is usually found when the initial value is much above the average. This "adjustment change" is independent of sugar concentration and moisture content, and is not found in wood or leaf.

3. This lability of protein and crystalloid N is more marked in the inner and middle zones of the bark than the outer, and is therefore probably specially important in the sieve tubes.

4. These observations suggest that all the N fractions, including the labile protein, contribute to longitudinal movement within the sieve tube, but that movement into and out of the sieve tube may be restricted to some crystalloid N fraction (possibly residual N), which does not take part in the rapid "adjustment

changes." Otherwise these changes would produce violent disturbances in the rate of transport of nitrogen about the plant.

B. *Response to Ringing.*—1. Accumulation of N not only in bark and wood, but also in the leaves above a ring, is definitely established. At the same time further confirmation is obtained of the spread of diurnal changes in total N-content from leaf to bark. These observations support the general conception of a gradient basis for N transport.

2. The response of protein and of crystalloid N in four ringing experiments may be summarized as follows:

(*a*) In two experiments there were rapid adjustment changes in the proportion of crystalloid N. In one the response was mainly crystalloid N, in the other protein. The type of response observed (protein or crystalloid N) would appear to depend on the mean level maintained by the proportion of crystalloid N during the interval between the time of ringing and the time of observation.

(*b*) In the other two experiments rapid adjustment changes were absent. The response was mainly crystalloid N in the first case, when the observations were made shortly after ringing, and mainly protein in the second, when observations were only begun after the interval of a day. This may be due to the effect of increased sugar concentration on the protein-crystalloid N ration.

3. The crystalloid N response is mainly a response of asparagine.

4. Radial spread from the sieve tubes into the other tissues of the bark and into the wood appears to be relatively greater for N than for sugars.

564. Effect of Sap on Fermentation by Some Yeasts. By E. J. Maskell and T. G. Mason. (*Trop. Agriculture*, vii., **6**, 1930, p. 160.) The authors write as follows: "We have recently had occasion in connection with our work on Transport in the Cotton Plant, to determine the effect of small amounts of expressed sap on the rate of fermentation of dextrose by some yeasts. Concentrations of sap as low as 0·1 cc. per 150 cc. of culture media* may bring about a significant acceleration in the rate of fermentation. The sap was boiled and filtered before addition to the culture media. Rates of fermentation were measured by periodical weighing of the cultures, and different cultures were compared on the basis of the time required to complete half the total fermentation possible. In this way we were able to determine that saps from different parts of the cotton plant may show well marked differences in capacity for activating fermentation. Thus fermentation by *S. ellipsoideus*, and by a strain isolated from Fleischmann's yeast, was promoted more vigorously by sap expressed from bark (cortex+ phloem) near the apical region than by sap expressed from bark near the base of the main axis. To test whether this downward gradient was connected with movement of the active substances along the bark, we compared saps expressed from bark above and below a ring on the main axis with saps expressed from the bark of corresponding regions of normal plants. We found a marked increase in the activity of the sap above the ring, but an approximately equal increase in activity below the ring. This suggests that wounding causes a local production of the active substances, and that downward movement, if it exists, is relatively unimportant. The existence of the local response, however, impairs the ringing method as a test of movement, and it would be unsafe to conclude that the active substances are not longitudinally mobile in the bark.

"We have also ascertained that *Nematospora coryli*, Pegl.,† one of the saccharo-

* Water, 2,000 grms.; dextrose, 240 grms.; ammonium chloride, 4 grms.; sodium di-phosphate, calcium chloride, yeast ash—each 2 grms.

† Ashby, S. F., and Nowell, W.: "The Fungi of Stigmatomycosis," *Ann. of Bot.*, xl., **157**, 1926. (*Cf.* Abstr. **596**, p. 387, Vol. IV. of this Review.)

mycetes that has been isolated from cotton bolls affected with Internal Boll Disease, can bring about the fermentation of dextrose, and that this fermentation is accelerated by small quantities of sap expressed from the young seed. The interest of these observations lies in the possibility that the pathogenicity of this group of organisms may depend in part on the high concentration of sugar in the young seed, and in part on the presence of growth accessory substances akin to Bios."

In a further paragraph Mr. S. F. Ashby, of the Imperial Bureau of Mycology, says that he has been able to confirm this last result.

565. CELL-SAP CONCENTRATION AND TRANSPIRATION AS RELATED TO AGE AND DEVELOPMENT OF COTTON LEAVES. By F. M. Eaton. (*J. of Agr. Res.*, 40, **9**, 1930, p. 791.) The sap concentrations and the temperatures of Pima cotton leaves varying in average age from 82 to 3 days were measured. These leaves were at successively higher nodes of the main stalks of plants grown without branches or bolls. The freezing-point depressions of the expressed sap from the leaves decreased from 1·57° C. for leaves 74 days old to 1·10° for leaves 10 days old. The specific electrical conductivities of the same saps increased from 0·0316 reciprocal ohms for leaves 82 days old to 0·0337 for leaves 62 days old, and then decreased to 0·0288 for leaves 20 days old. Young leaves were found to be cooler than old ones. The temperature of leaves 82 days old was 2·3° C. below that of the air, whereas the temperature of leaves 26 and 20 days old was 4·1° below. The temperature of very young leaves, 3 days old, was approximately the same as that of leaves 82 days old. The coefficient of correlation between the temperature and the sap concentration of leaves from 82 to 20 days old was $-0{\cdot}92 \pm 0{\cdot}035$ for the freezing-point and $-0{\cdot}86 \pm 0{\cdot}061$ for conductivity. Reference is made to an earlier paper in which it was shown that the differences in the temperatures of cotton leaves with different transpiration rates were inversely proportional to the transpiration differences. The plants defoliated for the leaf-sap measurements subsequently developed leaves of a more mesophytic character and of approximately three times greater size than the coincident leaves on similarly treated plants that had not been defoliated. The leaf-temperature and sap-concentration measurements are looked upon as furnishing an explanation of the stimulated leaf development on the basis of differences in the water relations of the new leaves on the two sets of plants. Young leaves of the cotton plants with their low sap concentration were less able than the old leaves to obtain water from the transpiration stream, and their higher rate of transpiration served to increase their requirements per unit of area.

[*Cf.* Abstr. **424**, p. 282 of Vol. VI. of this Review.]

566. DEVELOPMENT OF COTTON FIBRES IN THE PIMA AND ACALA VARIETIES. By R. S. Hawkins and G. H. Serviss. (*J. of Agr. Res.*, 40, **11**, 1930, p. 1017.) Fibre growth begins at the time of flowering irrespective of fertilization, and proceeds rapidly after fertilization, but ceases within a few days in unfertilized bolls. Elongation of Acala fibres was completed 21 days after flowering in the series which flowered July 13, August 3, and August 24; and 24 days after flowering in the series which flowered September 14. Pima cotton required 27 days for the elongation of the fibres in the first three series, and 30 days for those in the September 14 series. Lower temperatures probably caused the prolongation of the time needed for completion of fibre length in the September 14 series of both varieties. The fibres of both varieties made a daily increase in length of from three thirty-seconds to one-eighth inch at the time of their most rapid growth. The greatest increase in fibre length occurred about the twenty-first day after flowering in the Pima series, and from the fifteenth to the eighteenth day in the Acala series. No appreciable thickening of fibre walls began until fibre elonga-

tion was almost completed. The rate of fibre-wall thickening became less, with one exception, in each successive series as the temperatures declined. Fibre-wall thickening was completed in the Pima fibres 54, 48, 60 and 78 days after the flowering period in the July 13, August 3, August 24, and September 14 series. Acala cotton required 48, 54, 48, and 75 days for maximum fibre-wall thickening in these series. Fibre-wall thickening was completed in some instances at the time of boll maturity and in others a few days before maturity. The time of the season during which cotton fibres are developing affects the rate of fibre-wall thickening greatly, but does not influence the rate of fibre growth in length to any appreciable extent until late in the season. Prevailing temperatures contribute to the rate of fibre development, and when lower than necessary for optimum plant growth, have a retarding effect on both fibre elongation and fibre-wall thickening. Varietal differences in the development of length and wall thickness of cotton fibres as unlike as Acala and Pima are noteworthy.

567. NOTEWORTHY PHYSICAL PROPERTIES OF THE COTTON HAIR WALL. By W. L. Balls. (Internat. Botan. Congress, Cambridge, 1930.) A complex system of spiral reversals occurs in the wall structure, which is markedly anisotropic, its high tensile strength being due to end-to-end bonds. Swelling of cross-section, hysteresis, lag, and surging are also considered, as well as breaking stress, which is indeterminable on account of the porous cross-section of the wall itself.

568. SOME OBSERVATIONS ON THE BEHAVIOUR OF COTTON ROOTS IN DEEP SOIL. By J. Templeton. (Internat. Botan. Congress, Cambridge, 1930.) Plants were grown in glass-fronted pits with a steadily rising water table, on approaching which the rate of growth of roots diminished, ceasing just above it. The roots remained alive for a long time after submergence, the soil near them becoming blue-black from the reduction of ferric iron, which was gradually re-oxidized when the water table was lowered.

569. COTTON INVESTIGATIONS IN TEXAS. (*Texas Sta. Rpt.*, 1928. Abstr. from *Exp. Sta. Rec.*, 62, 7, 1930, p. 631.) The following excerpts from the abstract are of interest: "A cluster-type plant, probably a mutation in Durango cotton, was crossed with 10 varieties in attempts to develop a cotton better suited for machine harvesting. The cluster type of fruiting was found to be recessive.

"In crosses between long and short lint plants, long lint was dominant in F_1, while in F_2 some plants arose with lint longer and shorter, respectively, than that of either parent. Crosses between two strains each having 100 per cent. of 5-lock bolls produced progeny having a small percentage of 4-lock bolls, indicating that either the parent plants were heterozygous for this character or that production of 5-lock bolls may be affected by environment.

"In crosses between Egyptian and Upland cotton, the Egyptian was dominant in F_1 in regard to type of plant growth, fruiting habit, flower colour, leaf shape, lint length, seed fuzziness, lint percentage, and boll size. Continued inbreeding of certain strains of cotton for several generations has not resulted in any significant decline in plant vigour."

570. FRUITING HABIT OF THE COTTON PLANT. By T. S. Buie. (*Bull.* 261, Clemson Coll., S. Carolina, 1929.) A critical analysis of a number of the most promising varieties of cotton grown in, or believed to be adapted to, South Carolina, carried out with a view to determining the characteristics of each strain and its possibilities from the standpoint of future breeding operations.

[*Cf.* Abstract **105**, p. 89, Vol. VI. of this Review.]

571. COTTON PLANT: CYTOLOGY. By J. M. Beal. (*Biol. Abs.*, **4**, 1930, p. 305. From *Cellule*, **38**, 1928, p. 245. Abstr. from *Summ. of Curr. Lit.*, x., **12**, 1930, p. 312.) The chromonema of the premeiotic nucleus forms, by lateral approxi-

mation of strands, a double spireme which undergoes synezesis and later segments to form the haploid number (26) of bivalent chromosomes, the nucleole not contributing detectably to the chromosomes. There is no "2nd contraction," and no chromosome tetrads are found.

FIBRE, YARNS, SPINNING, WEAVING, ETC.

572. FIBRE-SORTING DEVICE. By G. Cahen and P. Chevalier. (*Revue Text.*, **28**, 1930, 735 and 737. Abstr. from *Summ. of Curr. Lit.*, x., **13**, 1930, p. 341.) The apparatus consists essentially of a revolving roller covered with wire gauze or perforated metal sheeting. The fibres are placed in a holder which is given a lateral vibration, and at the same time gradually raised so that the ends of the fibres are caught in the holes and carried round the roller, being thrown off on the other side. The device may be used for the classification of fibres according to length, and for sorting animal fibres.

573. THE SWELLING OF COTTON HAIRS IN WATER AND IN AIR AT VARIOUS RELATIVE HUMIDITIES. By G. E. Collins. (*Jour. of Text. Inst.*, xxi., **7**, 1930, T 311.) The swelling that accompanies the absorption of water by cotton does not appear to have formed the subject of any extensive measurements, in spite of its fundamental importance, though Haller records a 23 per cent. increase of diameter of bleached American hairs on passing from the dry state to a water medium. It might be anticipated that a close parallelism would exist between the extent of the dimensional changes and the amount of the absorption, and the measurements recorded in this paper indicate that this is so, at all events between the temperature limits 20° to 100° C. No evidence of increased swelling at temperatures up to 200° C. has been obtained.

574. PLANT FIBRES: CHEMICAL SECTIONING. By M. A. el Kelaney and G. O. Searle. (*Proc. Roy. Soc.*, B., 1930, **106**, p. 357. Abstr. from *Summ. of Curr. Lit.*, x., **13**, 1930, p. 342.) A simple method is described for obtaining thin transverse sections of plant fibre bundles by chemical means. The fibre is boiled in sulphuric acid, and without washing is then dried in an oven until it begins to char. The tendered fibre is mounted in caustic soda solution and submitted to suitable pressure, whereupon the fibre bundles segment into transverse sections. These sections are usually between 10 and 20 μ thick, quite flat, exactly transverse, and retain all the fine details of structure present in the untreated fibre. It is suggested that sections formed in this way will be a valuable aid to the routine identification of different fibres. Tentative suggestions are made as to the underlying cause of fibre segmentation. Sections of six kinds of fibre are illustrated.

575. COTTON BALES: MOISTURE CONTENT. Southern Textile Asscn. (*Cotton* [U.S.], **94**, 1930, p. 761. Abstr. from *Summ. of Curr. Lit.*, x., **13**, 1930, p. 333.) A report of a discussion. The results of tests of the moisture content of bales of Western cotton and Middling cotton, and of the finished scutcher laps are given, and reference is made to the lag in the establishment of equilibrium between the moisture in the bale and that in the air of the blowroom.

576. THE DRY WEIGHT OF COTTON. By G. F. Davidson and S. A. Shorter. (*J. of Text. Inst.*, xxi., **4**, 1930, T 165.) Deals with: The True Dry Weight; The Time Factor in Drying; The Effect of the Temperature on Drying; The Effect of the Hygrometric State of the Air; The Difference between Bleached and Unbleached Cotton; The Correlation of Different Apparent Dry Weights.

[*Cf.* Abstr. **467**, **473**, **475**.]

577. Automatic Opening and Scutching. By R. S. Curley. (*Melliand*, **1**, 1929, p. 179. Abstr. from *Summ. of Curr. Lit.*, x., **10**, 1930, p. 234.) The advantages of combining opening, conveying, and scutching into one fully automatic process are discussed, and a one-process scutcher is described. The essential features of such systems, which furnish a highly superior product, are fully automatic operation, maximum cleaning power with minimum beating, all beating done from loose cotton, thorough opening, blending and mixing of the cotton, fully synchronized control of all elements, proper maintenance of levels in the hopper of primary and intermediate feeders, and complete elimination of human judgment from the scutching process.

578. Fibre Opening and Blending Machine. By J. F. White and C. W. I. Leather (Cleckheaton). (Abstr. from *Summ. of. Curr. Lit.*, x., **12**, 1930, p. 296.) A machine for opening, cleaning, and mixing cotton, wool, and other fibres.

579. Cotton Cleaning Machinery. By J. B. Brennen (Atlanta, U.S.A.). (Abstr. from *Summ. of Curr. Lit.*, x., **12**, 1930, p. 296.) The patent (E.P. 327,593 of May 22, 1929) relates to an arrangement comprising a cleaner and a trunk system leading to a collecting cage.

580. Cotton Cleaning Machine. By J. A. Reedy. (Woonsocket, U.S.A.) (*J. of Text. Inst.*, xxi., **4**, 1930, A 183.) The apparatus comprises a pair of shafts rotating in the same direction, and carrying spaced sets of beating blades. The shafts are mounted in a chamber which comprises grid bars mounted in grooved frames at each end and enclosed in a casing. The bottom of the chamber is provided with a series of sharp-edged bars. The beating blades, in addition to opening the material, cause it to advance through the chamber and to be discharged through an outlet.

581. Oil-Sprayed Cotton: Opening, Carding, and Spinning. A. R. Marley. (*Text. World*, **77**, 1930. Abstr. from *J. of Text. Inst.*, xxi., **7**, 1930, A 345.) Comparative tests were made on both white and coloured stocks of oil-treated and untreated carded cotton. American cotton of $\frac{7}{8}$ to 1 in. staple, middling grade, was used, and 5 oz. Breton Minerol "E" were applied to every 100 lb. cotton. The white stock was spun into 21's and the coloured into 10's yarn. With white cotton the invisible waste was 3·62 per cent. for the oiled and 5·16 per cent. for the unoiled stock. The total waste through the intermediate and finisher scutchers was 0·19 per cent. less for the oiled than for the unoiled cotton. In the card-room the total waste was 6·74 per cent. for the unoiled and 5·83 per cent. for the oiled; the visible waste was 5·19 per cent. for unoiled and 4·73 per cent. for the oiled. The yarn waste was 12·49 per cent. through the cards for the unoiled, and 10·44 per cent. for the oiled. This makes a difference of 2·05 per cent. through the machines up to and including the cards. The unoiled coloured cotton had 3·24 per cent. invisible waste, and the oiled 2·65 per cent. The amount of visible waste for both the unoiled and oiled was practically the same. The total waste from the cards was 8·02 per cent. for the unoiled, and 5·93 per cent. for the oiled cotton.

582. Cotton Opening and Cleaning Machine. By W. Tatham, Ltd., and R. I. Berry (Rochdale). E.P. 324,652 of Jan. 5, 1929. (Abstr. from *J. of Text. Inst.*, xxi., **6**, 1930, A 296.) A machine for cleaning and opening cotton or other fibrous material, and comprising a stationary conical cylinder, the lower half of which is perforated, inclined plates arranged below the lower part to direct the small fibre into a trough containing a scroll or scraper, the material being fed through a shoot by a lattice or like feed mechanism, and the cleaned material being discharged from a tangential outlet on to receiving, feeding down, or forwarding mechanism—is characterized in that the conical cylinder has a plain

upper section, and the beater consists of a shaft with bars varying in length. More than one trough may be provided. The upper half of the cylinder is of sheet metal, and is formed with two sections adapted to open about hinges. A well having a hinged bottom and located adjacent to a corresponding opening in the lower part of the cylinder is provided to receive metal scrap or other heavy material. As shown, the material is delivered by centrifugal force on to a dust cage arranged below a hood and bearing on a driven roller.

583. The Spinning Value of Raw Cotton. By W. E. Morton. (*J. of Text. Inst.*, xxi., 5, 1930, T 205.) It was hoped that the experiments described in this paper would throw some light on the factors which determine yarn quality from the point of view of the raw material. Unfortunately, unavoidable circumstances arose which made it impossible to complete the scheme of research as originally planned, so that the conclusions have had to be based on observations on a limited number of both hair and yarn properties. Nevertheless, it is felt that such results as have been obtained, bearing, as they do, on the work already published by Balls and Turner, will be of interest and use to future investigators, and to that end this report is presented. During 1926 fifteen different cottons were obtained, representing a considerable variety of origin, and in order to simplify the investigation somewhat, an attempt was made to eliminate the effect of hair length by choosing cottons of nominally the same staple. These cottons were spun into a range of yarns of different counts and twist, and the results of the strength tests on the yarns were examined in relation to certain of the measurable characters of the raw materials.

The following are the more important of the conclusions reached, the assumption being made that mean hair length is constant:

1. Yarn regularity depends on hair fineness to a greater extent than on any other easily measured hair property. The influence of staple length regularity is relatively insignificant.

2. From the point of view of utility, the strongest yarn is obtained from most $1\frac{1}{8}$ in. cottons when the spinning constant is approximately 3·6.

3. Where it is necessary or desirable to use low-spinning constants, fine cottons give strengths more nearly approaching their maximum than do coarse cottons.

4. All other things being equal, fine cottons are capable of being spun to higher counts than are coarse cottons.

5. Yarn strength is apparently not at all affected by hair strength because of the masking effect of irregularity, and thus the strongest yarn will be produced not from the *strongest* cotton, but from the *finest.*

584. Preliminary Spinning Tests on Mixings of Indian and American Cottons Using Ordinary and High Drafts. By R. P. Richardson and A. J. Turner. (*Tech. Bull.*, Ser. A., No. 15, Indian Central Cotton Committee, 1930.) Experiments were made on 40 lb. lots of American (Texas) and Indian (C. P. Wun) cottons, spun upon four different systems, using 75 per cent. American and 25 per cent. Indian; 50 per cent. American and 50 per cent. Indian; and 25 per cent. American and 75 per cent. Indian. The following tentative conclusions are drawn:

(1) There is no difficulty in spinning a mixing of two types of cotton having mean fibre-lengths differing by 0·15 inch, when they have approximately the same fibre-weight per inch.

(2) On a good high draft system it is possible to spin as good a yarn direct from intermediate roving as from ordinary roving on the ordinary system.

(3) By spinning from double roving and using double draft on a high draft system, it is possible to obtain a yarn of decidedly higher quality than that produced on the ordinary system, with at least as high a rate of production.

(4) Using a mixing containing equal quantities of suitable American and Indian cottons, it is possible to spin on a high draft system a 20's yarn at least equal in quality to a similar yarn spun from the American cotton alone, with a considerable saving in the cost of the mixing and no loss in production.

585. Raw Cotton: Oil Spraying. By Textile Operating Executives of Georgia. (*Cotton* [U.S.], **94**, 1930, p. 611. Abstr. from *Summ. of Curr. Lit.* x., **11**, 1930, p. 260.) Reports from various mills are cited. One mill abandoned oil spraying because of the occurrence of spots on the goods, and another, using low pressure equipment, because of uneven distribution of the oil. In another mill high pressure equipment is used, and the oil applied at the entrance to the vertical opener. On white work 0·2 per cent. of oil is sufficient for all purposes, and 0·25 per cent. is recommended by a different mill for coloured work. Oil reduces the fly and dust in the cardroom. No difference is observed in the strength of the yarn, but the stock treated with oil is 1½ per cent. heavier than the untreated stock. The oil used must be emulsifiable in water. A table is given showing the waste at different machines with and without oil.

586. Oil-Sprayed Cotton: Spinning Quality. By J. H. Hilton and J. J. Brown. (*Melliand*, **1**, 1929, p. 360. Abstr. from *Summ. of Curr. Lit.*, x., **11**, 1930, p. 260.) An account is given of a test run to compare oiled cotton and untreated cotton. A middling cotton of $1\frac{5}{16}$ inch staple was used, and 0·25 per cent. of Breton Minerol E lubricant was applied at the breaker scutcher hopper with Breton Minerol Process equipment. Comparison was made of the amount of visible and invisible waste made up to and including carding, the working qualities of the cottons, the quality of the yarn spun, and operating conditions in reference to cleanliness of the atmosphere. The general conclusion from the results is that at the expense of 1½ lb. of the proper oil per bale of cotton, better running conditions can be obtained for the cotton, a better yarn made, and an increased production of yarn obtained, which, based on cotton at 22 cents per lb., has the value of 1·13 dollars per bale.

587. Raw Cotton: Oiling. Southern Textile Assen. (*Cotton* [U.S.], **94, 1930,** p. 819. Abstr. from *Summ. of Curr. Lit.*, x., **13**, 1930, p. 333.) A report of a discussion. The use of 0·3 per cent. of oil on raw cotton has been found to reduce dust and fly in the cardroom, with the result that the yarn has fewer slugs and gouts, giving fewer ends down in spinning. Much better results are obtained with the modern method of applying the oil in the conveyor pipe than with the old method of applying the oil in the hopper. Yarn-breaking strengths were slightly higher by use of oil.

588. The American Process of Oiling Cotton. By B. E. Govier. (*Text. Rec.*, xlviii., **567**, 1930, p. 32.) An interesting discussion of the subject. The present claims for the process are: The cotton cleans better; cards better; with a better web; roving is smoother; yarns are more even; less fire hazard; less invisible waste; better visible waste; increased elasticity; 50 to 70 per cent. reduction of dust and fly through the mill.

589. Raw Cotton Oiling Emulsion. By G. F. Edwards, Birmingham. (E. F. Houghton and Co., Philadelphia, U.S.A.) (Abstr. from *Summ. of Curr. Lit.*, x., **11**, 1930, p. 264.) A stable emulsion of a mixture of mineral and non-mineral oils in which the mineral oil is in excess of the non-mineral oil.

590. Raw Cotton: Effect of Quality on Products. By F. A. Robertson. (*Melliand*, **1**, 1929, p. 207. Abstr. from *Summ. of Curr. Lit.*, x., **10**, 1930, p. **234**.) The author affirms that insufficient attention is paid to the raw cotton used in a mill, and supports his argument by data showing the loss of strength of yarns

and fabrics produced from a cotton of which a small percentage was inferior to the stock that had previously been used. He emphasizes the need for testing deliveries of raw cotton and for good mixing.

591. HIGH DRAFTING IN COTTON SPINNING. By C. Barnshaw. (Pubd. by Ernest Benn, Ltd., London. 1930. Price 21s. Abstr. from *J. of Text. Inst.*, xxi., **6**, 1930, p. 110.) "The subject-matter in the book is well set out in proper sequence, which is a desirable feature not always found in textile publications, and can be appreciated to the full in this work. The work is well expressed, clear, easy to understand, and admirably illustrated. It is an invaluable book for all who are interested in high-draft systems and cotton spinning generally."

592. "HYGROLIT" YARN CONDITIONING MACHINE. By F. L. Bryant. (*Melliand*, **1**, 1929, p. 397. Abstr. from *Summ. of Curr. Lit.*, x., **11**, 1930, p. 264.) A more fully illustrated account than has previously been given. Samples of yarn before and after conditioning with Hygrolit are also provided.

593. A CIRCULAR LOOM. (*Int. Cot. Bull.*, viii., **32**, 1930, p. 718.) A loom invented by J. Jabouley, an employee of the Soc. Colombe Loom Works, Les Fils de Guillaum Diederichs, embodies revolutionary features of construction and operation, although it weaves cloth comparable in all respects with that woven on an ordinary loom.

594. AUTOMATIC LOOMS: APPLICATION IN EUROPE. By L. Geisser. (*Spinn. u. Web.*, 1930, 48, No. **8**, pp. 4-8; No. **9**, pp. 9-18. Abstr. from *Summ. of Curr. Lit.*, x., **10**, 1930, p. 237.) A survey is made of the use of automatic looms in European countries, and the organization of the American textile industry is described. The principal features of automatic looms constructed by central European firms are outlined.

595. AUTOMATIC LOOMS: APPLICATION. (*Spinn. u. Web.*, 48, **6**, 1930, p. 1. Abstr. from *Summ. of Curr. Lit.*, x., **9**, 1930, p. 215.) Types of automatic looms and the conditions necessary for successful application are discussed. Tables are given showing weavers' wages, on a payment-by-pick basis, for different numbers of looms per weaver up to 24, with different loom speeds and efficiencies.

596. AUTOMATIC LOOMS: COMPARISON. By A. Palmer. (*Melliand*, **1**, 1929, p. 57. Abstr. from *Summ. of Curr. Lit.*, x., **10**, 1930, p. 237.) Some comparisons have been made between the Crompton and Knowles Cotton King loom and older automatic looms. The figures are decidedly in favour of the automatic loom. By providing a battery hand, and assigning to the weaver enough looms to keep him busy without undue exertion (24), it is estimated that a saving of 8 per cent. of the total cost, including cotton, would be made.

597. SPONTANEOUS COMBUSTION OF COTTON. By D. L. Sen. (*Abs. Proc. 20th Mtg. Ind. Cent. Cotton Comm.*, 1929, p. 70.) Cotton containing 10, 20, and 27 per cent. of moisture in three separate sealed flasks was exposed to the sun for over six months; examination revealed no trace of any inflammable gas. Cotton exposed over water inside a small desiccator for about four months gave off a very obnoxious smell on opening. The water in the experiment became pink in colour, and rod-like (chromogenic) bacteria were isolated from it. A table is included showing the results of analyses of gases collected from the anaerobic fermentation for six months of dirty cotton, jute, and a mixture of cotton and jute in water in sealed bottles. The gas collected in each case was highly inflammable. The jute produced more gas than cotton, and acidity in cotton fermentation was much higher than in jute. No gas was collected from cotton exposed over distilled water in a large sealed desiccator for seven months, but

about 15 c.c. of gas was collected from the jute exposed under similar conditions. Cotton and jute each with 50 per cent. moisture content were kept in separate sealed chambers (in adiabatic condition) for over seven months, but no measurable rise in temperature was recorded, and on opening both cotton and jute were in their original moist condition. The conditions in these various tests do not represent actual conditions likely to be met with in the case of a fully pressed bale. Damp and dirty cotton in loose borahs may be said to approximate to some of the conditions, except that in actual practice any gas generated would be diffused in the surrounding air.

TRADE, CO-OPERATION.

598. REPORT OF COMMITTEE ON THE COTTON INDUSTRY. (*Cmd.* 3615, Pubd. by H.M. Stat. Off., 1930, price 6d. net.) The Committee was appointed by the Prime Minister on August 1, 1929, with the following terms of reference: "To consider and report upon the present condition and prospects of the Cotton Industry, and to make recommendations as to any action which may appear desirable and practicable in order to improve the position of that Industry in the markets of the world."

The Report of the Committee is presented under the following heads: Introductory; Comparison of Pre-War and Present Condition of the Cotton Industry; The Present Organization of the Cotton Industry; Technical Re-equipment; Closer Co-operation between Employers and Operatives; Reorganization; Conclusions; Recommendations.

599. CAUSES OF THE WORLD-WIDE DEPRESSION IN THE COTTON INDUSTRY AND POSSIBLE REMEDIES. By A. S. Pearse. (*Int. Cot. Bull.*, viii., **32**, 1930, p. 598.) The author states that amongst the causes which have upset the equilibrium between supply and demand in the cotton industry are the following: The post-war development of the industry in the East; "apparent" adoption of 48-hour week, with use of double shifts; increase in tariffs; civil war in China and unrest in India; low prices for agricultural products generally; the short skirt fashion, etc.; rationalization; low price of silver; deflation; American Stock Exchange crash; higher output under rationalization in Japan and U.S.A.; too short a working week in some countries and consequent high cost of production; the "instalment" system of payment; excessive taxation; antiquated trade union restrictions.

600. LANCASHIRE COTTON INDUSTRY: ECONOMICS. By H. Clay. (*Engineer*, **149**, 1930, p. 722. Abstr. from *Summ. of Curr. Lit.*, x., **14**, 1930, p. 387.) The author states that though cotton is depressed and has lost ground in the world's markets, Lancashire still exports as great a value of cotton manufactures as all the other cotton manufacturing countries put together.

601. LANCASHIRE COTTON INDUSTRY: ORGANIZATION AND RATIONALIZATION. By J. Wisselink. (Pamphlet, "The Concentration in the English Cotton Industry," Rotterdam, 1930. Abstr. from *Summ. of Curr. Lit.*, x., **14**, 1930, p. 387.) A translation of articles originally appearing in July, 1929, in the *Nieuwe Rotterdamsche Courant*, in which the author surveys the economic structure of the Lancashire cotton industry and the plans for reorganization.

602. RECENT INDUSTRIAL TENDENCIES. THE SUBSTITUTION OF KNOWLEDGE AND CO-OPERATION FOR INSTINCT AND COMPETITION. By H. G. Hughes. (*J. of Text. Inst.*, xxi., **5**, 1930, p. 90.) Deals with the development of the textile industries of Lancashire and Yorkshire on the principle of free competition, and discusses the failure of this principle at the present time.

603. Trade Organization: I. Cotton Spinning. II. Illustrative Forms. By F. Greenhalgh. (Pubd. by the author at 68, Albert Road West, Bolton, 1930, price £5 5s. Abstr. from *Jour. of Text. Inst.*, xxi., 7, 1930, p. 131.) The author's system provides, first, for the ascertainment of real costs on the soundest scientific costings principles; secondly, for an automatic check of the estimates on which the working costs are based; and, thirdly, a standard enabling all mills, no matter how circumstanced, to cost on a comparable basis.

604. South Africa: *Report on Co-operative Marketing during* 1927-28. (*Bull. No.* 74, Econ. Ser. No. 10, Dpt. of Agr., S. Afr., 1930, price 9d.) *Cotton.*—There are local co-operative societies in every important cotton-growing area in the Transvaal and Natal. These societies (seven in number) have a combined membership of 1,126 growers, and are all in turn members of the Central Co-operative Cotton Exchange, Limited, of Durban. The combined turnover during the 1927-28 season of these associations exclusive of the Co-operative Cotton Exchange was about £45,240 in produce and £23,658 in farming requisites. The associations owe their formation in large part to the absence of suitable ginning facilities in some of the cotton-growing areas, or dissatisfaction with the facilities provided by proprietary concerns. The advantage to be obtained by pooling and bulk sale was also an attraction. The cotton of all the local associations is sold through the Central Company, the Co-operative Cotton Exchange, in Durban, where it is found that demand is keen, the number of overseas buyers ensuring a comparatively free and competitive market. The Co-operative Cotton Exchange controlling supplies from a number of local associations is in a position to take advantage of the higher prices which buyers are usually prepared to pay for large lots of cotton of uniform grade and staple. The Co-operative Cotton Exchange is financed out of the levy imposed by the Government on cotton exported. This company, furthermore, has been conceded the right to consult with the Minister of Agriculture as to the disposition of the levy. There has been a reduced membership of the associations during the last two years owing to a falling-off in cotton production caused by adverse climatic conditions, ravages of insect pests, and poor prices.

605. New Uses for Cotton. (*Int. Cot. Bull.*, viii., 32, 1930, p. 745.) It is stated that 300 cities in U.S.A. are now using the cotton traffic markers of adhesive tape, as were shown in the spring textile exhibition at Manchester, and at the International Committee Meeting at Stresa in May.

606. New Uses for Cotton. (*Text. Rec.*, xlviii., 568, 1930, p. 75.) The work of extending the uses for cotton products in America continues unabated. Cotton bags for retailing potatoes in 10 and 15 lb. lots are coming into greater use, and experiments are now under way in the packing of Florida oranges in coloured cotton mesh bags that hold one-tenth of a box. Similar possibilities are seen for a consumer (cotton) package for pecans and other nuts in 5 lb. containers.

The U.S. Dept. of Agriculture states that power laundries are important consumers of cotton products, consuming approximately 52,000 bales of cotton annually. Cotton is consumed in the form of wash nets, twine, padding, sheeting, laundry bags, double-faced felt and cover duck. Wash nets alone account for 14,900 bales of cotton.

MISCELLANEOUS.

607. List of Agricultural Workers in the British Empire, 1929. (Pubd. by H.M. Stat. Off., 1930. Price 1s. net.) This list, which was originally prepared for the Imperial Agricultural Research Conference in 1927, has again been revised to show the names of the agricultural research workers and their investigational

subjects in 1929. The list gives the principal officers in the British Empire, the whole, or the major part, of whose duties consists in the carrying out of agricultural research. The present volume is divided into four parts: Part "A" is new and shows the personnel of the Imperial Bureaux; Part "B," the workers according to country; Part "C," the workers according to subject; Part "D," the list arranged alphabetically.

608. Abstracts of Papers on Agricultural Research in the United Kingdom (1928-29). (Obtainable Min. of Agr. and Fisheries, London. Price 1s. net.) A continuation for 1928-29 of a volume prepared for the Imperial Agricultural Research Conference, 1927. The papers abstracted have been limited to those dealing with results or methods of research work in agriculture, and, as in the previous volume, the abstracts have been made by the investigators themselves.

609. Report of the Conference of Empire Meteorologists, 1929: Agricultural Section. (H.M. Stat. Off. Price 1s. net.) This report deals, among other matters, with the origin and organization of the Agricultural Section of the Conference, and the scope and methods of agricultural meteorology. The recommendations made at the Conference are also included, and should be carefully studied.

610. Report of a Committee on the System of Appointment in the Colonial Office and the Colonial Services. (*Cmd.* 3554. Pubd. by H.M. Stat. Off., 1930. Price 1s. net.) This Committee was formed to consider the existing system of appointment in the Colonial Office and in the Public Service of the Dependencies not possessing responsible government, and to make such recommendations as may be considered desirable.

From the summary of recommendations we quote the following:

In the case of all appointments now made through the machinery of the Private Secretary (Appointments), the appointments staff should cease to be in the position of Private Secretaries, and the Appointments Branch should be incorporated in the Colonial Office as a permanent part of a Personnel Division of the Office.

A Colonial Service Appointments Board, consisting of a Chairman and two members—all to be nominated by the Civil Service Commission—should be set up as a standing, independent Board for the final selection of candidates for all such appointments, their selections being submitted to the Secretary of State, on whose authority the appointments would then be made. The Board should also have the oversight of the machinery of recruitment for all first appointments.

The long salary-scale system should be retained, but (*a*) the scales should be prolonged up to £1,000 in cases where at present they stop short of four figures by a small margin; (*b*) above some middle point in the scale a number of posts of suitable importance should be designated as higher-grade posts to be filled by selection on the sole basis of merit from among all officers on the scale, whether in the upper or lower half.

Free passages on leave should be granted to officers and their families by Colonial Governments.

The arrangements for the various courses of instruction should be carried out in the proposed Personnel Division of the Colonial Office.

With regard to the Tropical African Services Courses, it is desirable to aim at creating an effective link between the separate courses by means of a combined examination in the subjects of instruction common to each course. The desirability of instituting parallel courses at centres other than Oxford and Cambridge should be borne in mind in relation to the scale of recruitment.

Every encouragement should be given to the development of arrangements for study leave, whether at home or in Colonial Territories.

A single Colonial Service should be created, and within this larger whole unified special services should be organized with the necessary degree of assimilation of the terms of service in the separate Dependencies.

611. Textiles: Efficiency in Utilization. By Ruth O'Brien. U.S. Dpt. of Agr. (*Amer. Dyes Rpt.*, 18, 1929. Abstr. from *J. of Text. Inst.*, xxi., 4, 1930, A 204.) An outline is given of the activities of the Division of Textiles and Clothing of the American Bureau of Home Economics, Department of Agriculture. The cleaning and care of textiles, the effects of temperatures and reagents in laundering, the removal of stains, the effect of ironing temperatures and pressures, the sizing properties of starches from various plants, the stiffness of sized fabrics, durability of fabrics, and extended uses of cotton have been investigated. Bulletins, leaflets, magazine and newspaper articles, and broadcast talks, showing how the American textiles can be used to the best advantage in clothing and household articles, are being published.

612. "Kotonin" (Cottonized Flax): Properties and Application. (*Leipziger Monats. Text. Ind.*, 44, 1929. Abstr. from *J. of Text. Inst.*, xxi., 3, 1930, A 117.) Kotonin, a cottonized flax product, is to be prepared on a commercial scale in Leningrad. Flax stems will be subjected to the cottonizing treatment, but the tops of the fibre must be used for producing the better sorts of kotonin. The price of half-white kotonin is about the same as that of low-grade cotton. Addition of 30 to 35 per cent. of kotonin to wool improves the quality of wool cloths, whilst the addition of cotton reduces the quality. Kotonin is a good weaving material, but the dyeing of the product is not as yet sufficiently cleared up.

ADDENDUM.

(Received on the eve of going to press.)

613. Agricultural Research Work in the Sudan. (Obtainable from the Controller, Sudan Government Offices, Wellington House, Buckingham Gate, London, S.W. Price 2s. 6d., postage 4d.) This third volume includes a note explaining the reasons for the investigations at the Gezira Research Farm, and also the following reports:

Agricultural Report on the Gezira Irrigation Scheme, 1928-29.

Eleventh Annual Report of the Gezira Research Farm, 1928-29, and programme of experiments, 1929-30.

Reports of the Botanical and Plant Physiological Sections of the Gezira Research Farm, 1928-29, and Programmes of Work for 1929-30.

Seed Farm Report, 1928-29, and Programme, 1929-30.

Report by the Director, Wellcome Tropical Research Laboratories, on Chemical and Entomological Research in connection with cotton growing in the Gezira, 1928-29.

Work of the Chemical and Entomological Sections, 1928-29, and Research Programmes for 1929-30.

Report on the Section of Plant Physiology and Pathology, 1928-29, by Government Botanist, and Programme for 1929-30.

Work of the Plant Breeding Section, 1928-29, and Programme of Work, 1929-30.

PUBLICATIONS RECEIVED

We have to acknowledge the receipt of the following publications for the Library.

From Ministry of Agriculture, Egypt.

SALEM, DR. I. F.: *Cattle Plague in Egypt.* (*Bull.* 88, Tech. and Sci. Service.)

From Rothamsted Experimental Station.

CROWTHER, E. M., AND BASU, J. K.: *Note on a Simple Two-Compartment Electrodialysis Cell for the Determination of Exchangeable Bases.*

HEINTZE, S. C., AND CROWTHER, E. M.: *An Error in Soil Reaction Determination by the Quinhydrone Method.*

HISSINK, D. J.: *Soil Research :* Pt. I. *Results of Comparative Investigations on the Quinhydrone Electrode Method.*

From the Welsh Plant Breeding Station.

Grazing and Manurial Trials on Permanent and Prepared Swards, and Factors affecting Seed Production of Red Clover.

PERSONAL NOTES

APPOINTMENTS.

South Africa.

Mr. D. MacDonald has been transferred to Barberton to assist Mr. Parnell at the Cotton Breeding Station.

Swaziland.

Mr. J. V. Lochrie has been appointed to succeed Mr. MacDonald as Cotton Specialist.

West Indies.

Mr. S. H. Evelyn has been appointed Cotton Officer in charge of the Cotton Experiment Station, St. Vincent.

Dr. A. Skovsted has been appointed as Cytologist at the Cotton Research Station, Trinidad.

STUDENTSHIPS.

The Studentships awarded last year to W. L. Fielding, W. J. M. Irving, and J. D. Jameson have been confirmed for a second year, and will be tenable as follows: W. L. Fielding, at the Cotton Breeding Station, Barberton, Transvaal; W. J. M. Irving and J. D. Jameson, at the Imperial College of Tropical Agriculture, Trinidad.

Studentships have also been granted to M. F. Rose, C. G. Dobbs, A. M. Gwynn, B. R. Jones, and D. F. Ruston, which will be tenable for the first year as follows: M. F. Rose, at the Imperial College of Tropical Agriculture, Trinidad; C. G. Dobbs A. M. Gwynn, B. R. Jones, D. F. Ruston, at Cambridge University.

In addition to the above a special third year Studentship has been granted to E. O. Pearson, to enable him to study Economic Entomology at Harvard University.

The following holders of Studentships last year have received appointments as under:

Nyasaland.

Mr. S. T. Hoyle has been appointed by the Corporation as Assistant to Mr. Ducker.

Uganda.

Messrs. R. P. Davidson and A. J. Kerr have been appointed by the Uganda Government as Agricultural Officers under the Department of Agriculture.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to

cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the colonies.

At the date of writing, the following officers are on leave in England from cotton-growing countries:

Ceylon	Mr. A. W. R. Joachim.
,,	Mr. W. C. Lester-Smith.
Cyprus	Mr. M. T. Dawe.
Fiji	Mr. H. W. Simmonds.
Gold Coast	Capt. C. G. Coull.
,, ,,	Mr. J. M. Dunbar.
,, ,,	Mr. S. T. Phillips.
,, ,,	Mr. F. Pyatt.
Iraq	Mr. J. F. Webster.
Kenya	Mr. H. C. James.
,,	Mr. N. Spranger.
Leeward Islands	Mr. F. H. S. Warneford.
Nigeria	Mr. A. W. Anderson.
,,	Mr. K. D. R. Davies.
,,	Captain W. B. Dawson.
,,	Mr. L. P. Henderson.
,,	Mr. C. J. Lewin.
,,	Mr. G. W. Lines.
,,	Mr. B. G. Owen.
,,	Mr. J. V. R. Smyth.
Palestine	Mr. F. J. Tear.
Sierra Leone	Mr. F. J. Martin.
Tanganyika Territory	Mr. S. N. Bax.
,, ,,	Mr. C. Harvey.
,, ,,	Mr. R. M. Maynard.
,, ,,	Dr. J. V. Phillips.
,, ,,	Mr. A. H. Ritchie.
,, ,,	Mr. A. S. Stenhouse.
,, ,,	Mr. G. B. Wallace.
Uganda	Mr. P. Chandler.
,,	Mr. D. S. Davies.
,,	Mr. A. B. Killick.
,,	Mr. E. F. Martin.

The following officers of the Corporation's staff abroad are on leave in this country:

Northern Rhodesia	Mr. A. C. Bebbington.
Nyasaland	Mr. W. L. Miller.
South Africa	Mr. S. Milligan.
,, ,,	Mr. O. V. S. Heath.

THE EMPIRE COTTON GROWING REVIEW

INDEX OF AUTHORS TO VOL. VII.

GENERAL INDEX TO VOL. VII.

PRINTED IN GREAT BRITAIN BY
BILLING AND SONS LTD., GUILDFORD AND ESHER